UNIV. OF
TORONTO
LIBRARY

echn
M.

Michigan Engineers' Annual

1898

The Root Improved Water Tube Boiler

FURNISHES
DRY STEAM.

Absolute
Safety,

With HIGHEST
POSSIBLE
ECONOMY.

Abendroth & Root Mfg. Co.,

Send for Catalogue. 28 CLIFF ST., N. Y.

LIDGERWOOD

HOISTING ENGINES

Are built to gauge on the Duplicate Part System. Quick delivery assured.

STANDARD FOR QUALITY AND DUTY

For Engineers, Contractors, Builders, Railroads, Pile Driving, etc.

300 STYLES AND SIZES.
Send for Latest Catalogue.

13,000 IN USE.

LIDGERWOOD MFG. CO.,

96 LIBERTY ST., N. Y.

When answering advertisements, please mention "Michigan Engineers' Annual."

REVIEW & HERALD PUB'G CO., BATTLE CREEK, MICH.

98

Dr. C. Reasons

H. C. PEARSONS.

From the Grand Haven "Daily Tribune."

In the death of Harrison C. Pearsons, which occurred this morning at his home in Ferrysburg, Ottawa County loses one of its best-known and most remarkable citizens. The death summons had long been expected, as the venerable old gentleman had been ailing for a long time, and death came as a relief after long months of suffering from repeated paralytic strokes.

Mr. Pearsons was born on Jan. 25, 1819, in Allegany County, New York, and his boyhood days were spent there and in Jefferson County. He early evinced a liking for the higher sciences and mathematics, and by arduous study and an ambition to succeed, reached a high pinnacle in civil engineering, and became an authority in the engineering world.

He became an expert shipbuilder early in life, and for a long time was in the employ of the Northern Transportation Co., in building ships at Ogdensburg, N. Y. In those early days of lake navigation the Northern Transportation Co. was the leading one on the lakes, and maintained a handsome fleet of boats, that touched at every important port on the lakes. Many of these ships were constructed by Mr. Pearsons, and were among the finest afloat on fresh water.

In 1866 Mr. Pearsons came to Michigan, and established a shipyard at Ferrysburg. From this yard were turned out many fine boats, among the number being the schooners "Laketon," "Major N. H. Ferry," "R. R. Mason," "J. I. Case," "S. C. Knapp," and many others.

During General Grant's administration, Mr. Pearsons was appointed U. S. inspector of hulls, and this position he held for ten years, until succeeded by Captain Dodge.

In his later years Mr. Pearsons has been employed quite extensively in the adjustment of ship compasses and in such like work, and in that capacity has visited many of our lake ports. Although he had never sailed, he was fully competent

MILWAUKEE HYDRAULIC CEMENT.

Best Natural Cement in the World.

CAPACITY, 4,000 BARRELS PER DAY.
ANNUAL SALES, 500,000 BARRELS.

Correspondence Solicited.

FOR UNIFORMITY OF GRIND, AND ULTIMATE STRENGTH, IT STANDS UNRIVALED.

MILWAUKEE CEMENT CO.,

Room 7, Plankinton Building, - - MILWAUKEE, WIS.

Prompt Shipment Guaranteed.

to navigate a vessel, as he had made navigation a life study, and was a thorough student in that subject.

Deceased was one of the founders of the Michigan Engineering Society, and at the nineteenth annual meeting of that society in Port Huron last December, it was unanimously voted that he should be placed on the list of honorary members, in recognition of his many valuable services to the society. Engrossed copies of the resolution were sent to Mr. Pearsons.

Mr. Pearsons has been for many years a regular contributor to nautical journals, and was the author of a very valuable treatise on "Navigation." His views were always sought after on such matters, as being very valuable.

Probably Mr. Pearsons's greatest achievement was his invention of a solar attachment for surveyors' transits, by means of which true north and south lines can be obtained by solar observations, irrespective of any deviation of the compass. Buff & Berger, the world-wide famous firm of scientific instrument manufacturers, make this instrument, and some years since presented Mr. Pearsons with a valuable medal, in recognition of his great services to the scientific world.

As will be inferred from this altogether too brief sketch of an honored life, Mr. Pearsons has always been a busy man. In his business, in his official capacity, and in scientific research, he aimed to a high ideal, and had reached it.

Even in his very latest days, after he had retired from active work; he continued to write occasionally on practical engineering subjects. Road building he had made a thorough study of, and his papers on that important subject published in the *Tribune* and in the Grand Haven *Courier-Journal,* were very complete and authoritative, and were widely copied by the State press. Though dead, the works of Mr. Pearsons will live after him, and continue to be regarded as authority.

Mr. Pearsons was a man of fixed convictions, in favor of every principle of right and justice, and possessed the courage to defend them. His life was replete with good deeds, and he always gave a helping hand in every enterprise that had in view the advancement of civilization and the betterment of the

The... Deane

Write for 1897 Catalogue....

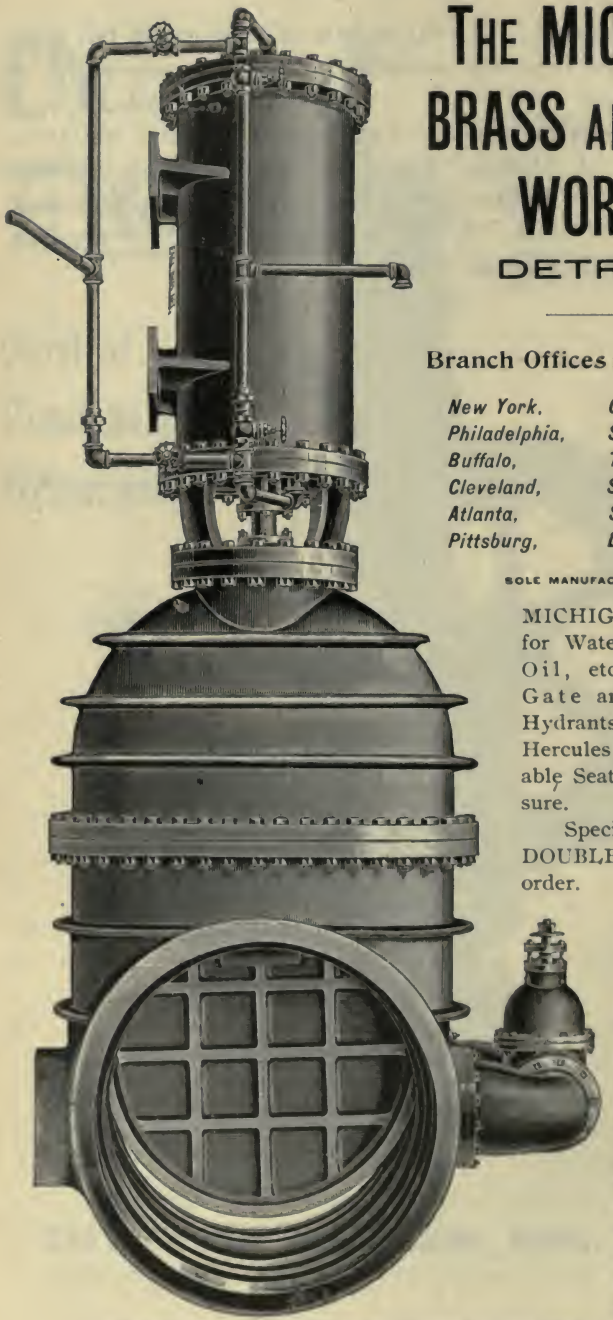
Vertical Condensing Apparatus.

The Deane Steam Pump Company, Holyoke, Mass.

When answering advertisements, please mention "Michigan Engineers' Annual."

condition of mankind. If the mantle of such could fall upon men who linger here, the social and political worlds would be much improved.

Mr. Pearsons is mourned by his wife and five children, Herbert W., of Duluth, Albert C., of Colorado Springs, C. Alton, of Duluth, Mrs. Byron E. Parks, of Ferrysburg, and Harry D., of Duluth. A brother, Galen W. Pearsons, is a civil engineer in Kansas City.



THE MICHIGAN BRASS AND IRON WORKS,

DETROIT.

Branch Offices:

New York,	*Chicago,*
Philadelphia,	*St. Louis,*
Buffalo,	*Tacoma,*
Cleveland,	*Salt Lake City,*
Atlanta,	*San Francisco,*
Pittsburg,	*London, Eng.*

SOLE MANUFACTURERS OF

MICHIGAN Gate Valves for Water, Steam, Gas, Oil, etc.; MICHIGAN Gate and Compression Hydrants; MICHIGAN Hercules Valves, Removable Seats for High Pressure.

Special SINGLE and DOUBLE Gate Valves to order.

Send for Photographs and Catalogue.

This Valve is for 100 pounds working pressure, 200 pounds test pressure. We have made 12 of these valves for the water works of Detroit, and they are giving perfect satisfaction.

OUR COUNTRY BYWAYS.

F. HODGMAN.

Mr. Toastmaster, Ladies, and Gentlemen: In speaking on this topic, I shall pass over familiar ground, and shall touch upon one point in which I feel a special interest. In bringing out that point, perhaps I cannot do better than quote from an article of mine recently published in one of our leading agricultural papers on country-road making: —

"The first thing to be done after locating the road is to clear the road-bed of trees, stumps, and such other impediments as there may be in it. Right here I enter my protest against the extra clearing that is sometimes done. There has been so much timber-cutting which was necessary to be done to bring our land under cultivation, that many people have learned to look upon a native tree or bush as an enemy, to be destroyed forthwith. Now, I say, by all means take out of the roads all of the native growth that is necessary for the purpose of making a good road; but when that is done, go slow about taking out the rest. I ride many a mile about the country for my health and pleasure, and the roads that I like best are those where the waysides have been left to grow up very much as they please. There, in the hot days of summer, the oaks and the hickories and the elms and the maples make a cool and grateful shade. There the spring beauties and buttercups and crane'sbills and violets and goldenrod and other sweet wild flowers abound. There grow the hazelnuts and the sassafras and the sumac, which glow with their browns and yellows and scarlet when the autumn comes. There the snow lies quietly where it falls in the winter, and there I always find the best sleighing. In good truth, we find along some of our country waysides about all that is left of the glorious beauty which once made Southern Michigan such a paradise for its pioneers. And yet every year these pleasant country roads are becoming barer, and the wild growth is being des-

Established 1880. Telephone. 2515.

W. H. DOYLE.

Cedar Railroad Ties, Etc.

Paving, Fence Posts, Telephone Poles, and Pulp Wood.

92 Griswold St., - - DETROIT, MICH.

SUPERIOR GRAPHITE PAINT

For Bridges, Roofs, Structural Iron, and All Exposed Metal or Wood Surfaces.

WARRANTED NOT AFFECTED BY HEAT, COLD, SALT BRINE, ACID FUMES, SMOKE, OR CHEMICALS.

DETROIT GRAPHITE MFG. CO., Detroit, Mich.

The Duplex . . .

Catch-basin Covers and Inlets

Are a radical departure from the old style. Their pleasing appearance makes them very desirable for fine residence sections.

Write for descriptive circular.

GEO. M. PIERCE, 8 Euclid Ave., CLEVELAND, OHIO.

Union Water Meter Company,

WORCESTER, MASS.

WATER METERS

For all kinds of service.

Water, Steam, and Gas Pressure Regulators.

Send for circulars.

troyed, for no apparent reason except that somebody hates the sight of a native bush or tree."

Since this topic was assigned me, I have put some of these thoughts in verse, and I hope they may have some influence in preserving, and in time adding to, the beauties of our country waysides.

I love in the wild-country byways to rove,
When springtide is swelling the buds in the grove,
When ferns are uncoiling themselves from the ground,
When Jack-in-the-pulpits and cowslips abound
And blue Johnny-jump-ups are scattered around
With spring-beauties, wild lilies, and roses.

I love in the back-country byways to roam,
To be with the thrush and the blackbird at home,
Where the woodpecker drums on some dry hollow tree,
And the red squirrels race in exuberant glee,
Where the bees and the humming-birds gather their fee
From the buttercups, clover, and daisies.

I love in these back-country byways to roam,
When the hot, dusty days of the summer have come,
Where the broad leafy tree-tops protect from the heat,
And bluebells and violets bloom at my feet,
'T is there I find rest and contentment complete,
'Mid the tall nodding grasses and posies.

I love in the back-country byways to roam,
When the glorious days of October have come,
When the oaks are still clad in their mantle of green,
When the maples and sumacs in scarlet are seen,
And orange and yellow leaves peep out between
Them from sassafras, aspens, and walnuts.

I love in these wild-country byways to rest,
And be of the robin and blue jay the guest,
To sit on some old mossy log at my ease,
Where the squirrels are dropping down nuts from the trees
And the quails with their little flocks roam as they please
Through the brown, dusty leaves by the wayside.

I love through those byways in winter to ride,
With content in my heart, and my wife by my side,
Where the white, fleecy snow lies in peace where it fell,
And the sleighing is best in the thick, woody dell;
When there comes from afar the sweet tone of a bell,
And the stars scatter gems by the wayside.

$4.50

...WORTH OF...

Standard Electrical Books

ABSOLUTELY

FREE

If you want to know how to procure these books, write us.

This offer is open for 60 days from June 10, 1898.

THE ELECTRICAL ENGINEER,
120 LIBERTY STREET, NEW YORK, N. Y.

The Crown Fire Clay Company,
The Robinson Brothers Clay Company,

Works: AKRON, O., CANAL DOVER, O.
Office: AKRON, O.

MANUFACTURERS OF

Capacity, 300 Tons Daily.

AKRON SEWER PIPE,

CULVERT PIPE, GLAZED DRAIN TILE, AND OTHER CLAY PRODUCTS.

When answering advertisements, please mention "Michigan Engineers' Annual."

THE ENGINEER'S ASSISTANT.

WM. B. SEARS.

LADIES AND GENTLEMEN: Our worthy president has assigned me a very difficult task; viz., "The Engineer's Assistant, and, What kind of man should he be?" A very worthy friend of mine who has had some very rough experience in Michigan and Wisconsin on the location of railway lines, says in a recent letter, "It is thawing again, and we are getting wet feet. When an engineer is born, nobody seems to think of having him web-footed as he ought to be. His backbone and ribs ought to be vulcanized rubber, and his cheek of brass!" Now, I am not web-footed, and most of those here present, knowing my timidity and diffidence in the past, will hardly accuse me of wearing brazen cheeks. As to the backbone and ribs, he's O. K.; but in ornamenting the cheeks with brass, "I think" he is away off; because, according to modern methods of doing business, and the speedy development of the new woman, it is barely possible the assistant should not be a man at all, but a comely, intelligent, sound, honest, well-developed woman!

I have generally found the man assistant, during the molting season,—that is, during courtship and marriage,—of very little use, and if any of you gentlemen expect a busy season's work in 1898, and have occasion to use the "assistant engineer," among the first questions to be put would be these: "Are you married or single?" "If single, are you deeply in love, and do you expect to marry this year?" If his answer and his blushes indicate that he is "clear gone," and about to marry, don't engage him just then; give him a little good advice, express your regrets, etc., and ask him to "call again" when "the honeymoon begins to wane." I'll give you the reasons why: Some twenty-five years ago I had occasion to take charge of a railway line seventy-five miles long, that was

THE AIR LIFT PUMP

WILL RAISE five to eight times more water, under most conditions, than any other system.

WILL OPERATE at great depths, beyond the reach of suction pump.

Any number of wells, far apart, may be operated from an economical central plant.

No wearing parts in wells to need adjustments or changes for years, if properly installed.

Aerates and purifies water automatically, and without extra cost, preventing vegetable growths, throwing off sulphur, iron, gases, etc.

Installed in accordance with our latest practise, and in connection with one of our High-Duty Air Compressors, it is economical as well as expedient.

We have installed the largest number of municipal and private plants, have had the most experience, are manufacturers and licensees under the original patents granted to Dr. J. G. Pohle, and have developed the Air Lift to its highest efficiency.

THE INGERSOLL-SERGEANT DRILL CO.,

New York, CLEVELAND, Chicago.

When answering advertisements, please mention "Michigan Engineers' Annual."

being located and constructed in this State under the supervision of two young engineers,— very capable and clever gentlemen, and one of them a particular friend of mine at that time, who has continued such from joyous youth and the bright and happy days of vigorous manhood to this day,— and what do you think I found there? It was down in that beautiful country, the vicinity of Northville and Milford, the garden of Michigan, where good water, fine stock, and *handsome women* abound. A lull in the work, for want of funds, had occurred, and these gentlemen were holding over under pay,— studying human nature, making love to the buxom country girls, and *finally* "getting married." In looking over their field books, maps, and records, what did I see? Blank — blank — blankety blank; the most provoking blanks that an earnest, busy man, anxious to get ahead and put work in shape under a *new* schedule and new contractors, ever encountered. After picking up the meager notes, books, maps, and profiles (the love letters excepted of course), I had to go to the county seats and copy maps of record to know where I was at,— where the road was located, and *what* these boys had been doing. I was so put out, vexed, and annoyed, that I wrote to the management, saying, "The best of men are of little worth, and I would not give a tinker's whistle for them during the courting and marrying season."

Now, to be serious and come down to business, what 's the use of discussing the engineer's assistant at all? It has been hard sledding for the "old man," without an assistant, for the past five years, and no doubt the largest number of our profession (I mean railway engineers) have been compelled to flee to the woods, fields, farm, and factory for subsistence, and if the letters I receive monthly are any indication of existing conditions, they have failed to find work at living wages, in any department of labor. This condition is terrible to contemplate in this "great, free country of ours," and I am more inclined to recommend to the young student, after mastering mathematics, mechanics, and drawing, a better and deeper study of the science of government, so that he may be instrumental in

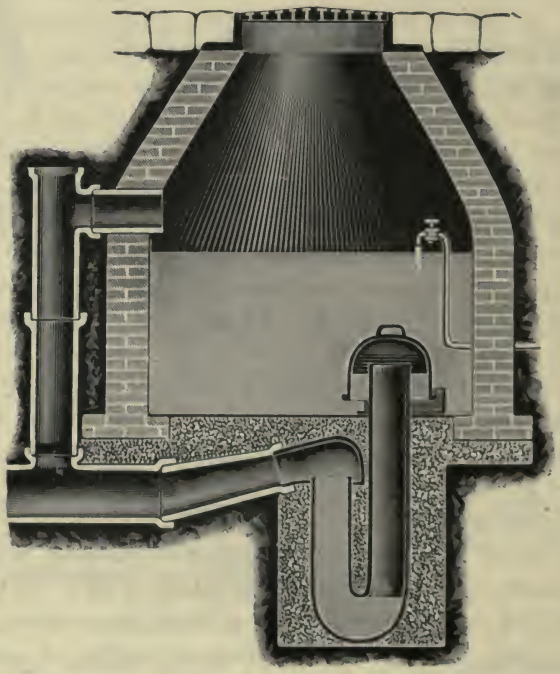
PACIFIC FLUSH TANK CO.,

84 La Salle St., Chicago,

MANUFACTURERS OF

THE MILLER AUTOMATIC SIPHON,

For Intermittent Flush Tanks.



USED FOR FLUSHING SEWERS AND FOR SUBSOIL IRRIGATION.

No Moving Parts! No Joints! No Little Traps! Received Highest Award in its Class, World's Columbian Exposition, 1893, for

Effectiveness, Reliability, Simplicity of Construction.

PORT HURON, MICH., February 20, 1896.

PACIFIC FLUSH TANK CO., Chicago, Ill.

Gentlemen:—We placed six of your Miller Automatic Siphons in our Ninth and Tenth Ward sewer systems, built last fall, and *they are giving excellent satisfaction.* These siphons consist of but two pieces of cast iron, with no movable parts, and I can see no possible chance for them ever to get out of order. (Signed) F. F. ROGERS,
City Engineer.

When answering advertisements, please mention "Michigan Engineers' Annual."

changing somewhat the conditions of the "mechanical age," and secure *for himself and his family a fuller and more equitable distribution* of the products of labor. When we compare our annual earnings, our financial condition, with that of the average politician, and the vast majority of the acute lawyers, that now misgovern the country and serve the privileged classes by putting up cunning schemes to rob the inventor, and the other busy bees in the industrial hive, our youth are inclined to think *and see* that selfishness, duplicity, and cunning bring larger rewards than ability, earnest effort, strict integrity, and devotion to duty. Without fixed principles, and a better knowledge of history and the science of government, they are apt to be led astray in pursuit of the almighty dollar, instead of striving under all circumstances and conditions to arrest fraud and prevent legalized plunder.

It is said, "There is always room at the top," and, "He that hath ambition, industry, and brains, should strive to get there." We cannot *all*, under any circumstances, reach the top rung of the ladder, and when nearing "the top" we should never forget "our brother" at the bottom, who is struggling with desperation to keep his head above water and secure for himself and his family a little of the sunshine, gladness, good things, and joys of life.

The discoveries in science and the useful arts have become so numerous, varied, deep, and far-reaching in their scope, that the assistant, if he possessed the intellect of a Newton, and lived to the age of Methuselah, could grasp and become familiar with only a small portion of the field. How shall I, then, who "just grew," like "Topsy," on the farm, 'way down in the good old States of Virginia and Ohio, give *you* pointers about the qualifications of the average man, "the assistant," without any special preparations for the work in which I am now engaged, except hunting, fishing, farming, growing hogs and cattle, and making corn whisky, under the tutelage of a wise and shrewd old Yankee gentleman from Connecticut, by the name of James Granger — "Jimmy Granger" he was called by the country people roundabout. He owned a

THE
TOLEDO BRIDGE COMPANY

Toledo, Ohio.

DESIGNERS AND BUILDERS OF

Bridges, Viaducts, Roofs,

AND ALL KINDS OF STRUCTURAL

STEEL WORK.

Heavy Plate Girders a Specialty.

Crown, Empire, Nash, Gem

WATER METERS.

The best in the world. Over 194,000 in use to date. Make no mistake. Buy the best.

National Meter Company,

318 Dearborn Street, CHICAGO.

NEW YORK. *BOSTON.* *LONDON.*

When answering advertisements, please mention "Michigan Engineers' Annual."

large estate of broken, hilly land, intersected by a mill stream, on which were located two grist-mills, a sawmill, and a distillery. We made pretty good whisky in those days for twenty-five cents a gallon, and nobody went dry that cared to "take a nip." As a youth, I did not indulge, because we had a magnificent orchard, and apples in great abundance, the finest and best varieties I have ever seen, and cider without stint, for a dollar a barrel. On the heavily wooded ridges there were chestnuts and wild grapes, and 'coon and 'possum to hunt in the moonlight nights of autumn. Toothless and gray as I am, it makes the mouth water to think of those yellow, juicy apples, delicious grapes, and fat 'possums, when I was playing the part of assistant to "Uncle Jimmy Granger."

(Speaking of things good to eat and drink suggests the thought that here is the place to warn the young assistant to guard against the drink habit, and wait patiently until he is past sixty, at least, before he indulges to any great extent without consulting his physician. I have seen so many good-hearted, brilliant men "go to the devil with lightning speed," by forming bad habits with boon companions in early manhood, that I advise them to guard against temptation, and firmly and resolutely say, "No, I am sorry to displease you; but I cannot injure my health and damage my reputation to gratify ANY MAN.").

He was great on building roads and bridges, and constructed two of the best wooden bridges, of one hundred feet span, on which he secured patents, that could be found in that region. When covered, they were good for forty years' service by simply renewing the floors and floor joist. While he was a success on roads and bridges, he was a complete failure on damming the mill stream. While he had plenty of "dam sites," and dams were in constant demand, I never knew him to construct a dam to withstand the angry June floods that came tumbling down Jonathan's Creek. He was a great experimenter, and would have his own way in all things, until repeated trials proved the idea or plan a failure, when he would scratch his head, retire for a night's study, and failing to solve

THE ENGINEERING MAGAZINE

It is the province of THE ENGINEERING MAGAZINE not to rival any of the excellent technical journals devoted to special branches of engineering work, but to supplement them all. It is absolutely indispensable to the engineer, whatever his specialty, because it not only presents, each month, striking original articles of prime interest in his own field, but, in addition, its Monthly Review and Index of the Engineering Press keeps him in full touch with the broad advancing front of his profession.

Leading Articles and Illustrations.

The leading articles are devoted to the most advanced movements in the engineering world. The range of the Magazine is international. Its contributors include the most eminent practising engineers and engineering teachers of America and Europe — men whose work and reputation establish the unquestionable authority of their conclusions. The treatment is based upon the realization of the necessary and growing interdependence of all departments of engineering science, and, while sacrificing nothing of value to the specialist, it recognizes the claims and interests of the man whose study or practise is general. And a wealth of original and admirable engravings are used whenever their presence adds to the effect and force of the treatment.

The Review and Index of The Engineering Press.

Excellent as are the leading pages of THE ENGINEERING MAGAZINE, they by no means sum up its total value. The most commanding feature of the Magazine is its monthly descriptive Index to the current periodical technical literature of the world.

Hundreds of the best engineering journals are constantly read by experienced reviewers, every article of importance is carefully indexed with a descriptive note indicating its character and purpose, and the whole systematically classified each month. The enormous scope and priceless value of the work may be best indicated by the following summary for the year 1897: —

In the Department of	Articles Indexed.	Articles Reviewed.	Totals.
Architecture and Building	718	42	760
Civil and Municipal Engineering	1214	95	1309
Economics and Industry	479	37	516
Electrical Engineering	1161	55	1216
Marine Engineering	289	21	310
Mechanical and Steam Engineering	1016	68	1084
Mining and Metallurgy	1116	45	1161
Railways and Tramways	1247	46	1293
Grand Totals	7240	409	7649

This means that a monthly average of nearly 640 leading articles of permanent value were thus placed at the instant disposal of the readers of the Magazine, the more important ones being comprehensively reviewed. THE ENGINEERING INDEX is, in fact, the one medium by the aid of which busy men can keep in constant touch with every department of the engineering world.

Write for a sample copy.

THE ENGINEERING MAGAZINE, 120-122 Liberty St., New York.

the problem, turn the matter over to his boss carpenter, and find business in the city for a few days until his failure was partially forgotten. He always kept a good, skilful boss carpenter, and paid him well, and after "Uncle Jimmy" had retired from the field, this man was sure to get hints and suggestions from all the wise men, and women, too, as how best to make a success of the job and please the old man, for he was generous and kind, and they all loved him. No, not all; a few idle drones, "dead-beats," and drunkards did not like his eccentric, aristocratic tastes; because he insisted on a lump of loaf sugar in his tea, and a silver spoon, while they had to eat with pewter and brown.

My father resided on "Uncle Jimmy's" farm, and conducted the farming industries for some years; and it was here, in handling the best machinery in use fifty-two years ago, and taking a practical part in all the operations of this busy life, that your humble servant gained more useful knowledge to enable him to handle men and conduct surveys and locate railway lines,—with a moderate share of success,—than was gained from the schools and the books. I was early and thoroughly drilled in reading, writing, and arithmetic, a smattering of grammar, and a pretty good knowledge of algebra, geometry, trigonometry, and surveying, Comstock's philosophy, and Combis's physiology, and in looking backward over the field, forest, and swamp traversed by this weak body during the past forty-five years, I think the last study the most useful of all, because it enables the man without constitutional defects, to maintain good health and keep constantly on duty. To-day, with all the good books, schools, and colleges accessible to the young man possessing a grain of industry, ambition, and courage to forge ahead, I find them deplorably ignorant of, and sadly lacking in the disposition to take proper care of, the body, so as to maintain sound health and regular service. I don't know what my companions here, past middle age, who have had extensive experience in working young men, will say about gross eating and the discomfort and annoyance resulting therefrom; but, honestly, I have found many of them more

In successful use
for the past 50 years.

Union Akron Cement Co.,

Sole Manufacturers of the

Akron Cement

STAR BRAND.

Capacity of Works,
2,000 Barrels Daily.

OFFICE, - 141 ERIE ST.,

BUFFALO, NEW YORK.

Michigan Agricultural College.

The work of Engineering at M. A. C. is carried on in the departments of **Civil, Mechanical, and Electrical Engineering.** Graduates from the regular four years' course in engineering awarded the degree of B. S. in **Mechanical Engineering.** Modern equipment in the shops, laboratories, and for the field. Excellent reference library. **We have one of the Strongest Courses in**

Scientific and Practical . . AGRICULTURE

in the world, leading to the degree B. S.

A Women's Department, well equipped and designed for instruction in the arts of the home as well as in general science and literature; also leading to the B. S. degree.

Special Winter Courses for young farmers and fruit-growers who want to pack their education into small compass.

All these courses are given under direction of first-class instructors. **Expenses are low.** No tuition to residents of Michigan. Send for catalogue. **J. L. Snyder, Pres.,** Agric'l College.

When answering advertisements, please mention "Michigan Engineers' Annual."

like pigs than men. Take a young sprig just out of school, strike an orchard loaded with apples half-ripe at 11 : 00 A. M., — he is hungry, of course,— and he will leave the line and load up with apples enough (unless you watch and warn him), when properly diluted with water, to make a barrel of Michigan cider, and on top of this, to hold it down, he consumes a hearty dinner, and later, a supper that makes the cook stare and wonder. What is the result? After listening to the commotion and his groans at the farm-house on the night following, we feel in the mood of the nervous gentleman who was placed in the same bedroom at Short's Hotel with the fat, overfed, loud snorer. Soon after retiring, the fat man began to tune his nasal organ — moderately at first, with an occasional pause, then more frequently and louder, until the "twangs" and "haughs" were a torture to the nervous man. All at once the fat man gave a terrible snort, turned over, and was silent as the grave, when our nervous friend exclaimed : "There! There! Thank God, *he is dead*, he is dead." I knew a rugged Irishman, a new-comer, fresh from the Emerald Isle, hind chainman in our party in 1853, who, short on potatoes for supper, ate *seventeen* fair-sized apples, without paring one, just before retiring for the night. Being the forward chainman, unfortunately, I had to sleep with Paddy that night, and it was awful! I am sorry to say, *he lived;* and yet he was an educated man.

My experience with these gluttons has been sometimes sad, sometimes very ludicrous, and has often led me to believe that intemperance in eating is about as sinful as overdrinking, and perhaps more destructive to human life.

Now, gentlemen, speaking for the young man, the "beginner;" for these old sinners I see around me here have all passed through the mill, and would not listen to a man fond of sweet cider, apple-jack 'possum, and persimmons, did he possess the industry and genius of a Stephenson, a Roebling, or an Eads : Our work is nearly done, habits formed, fixed, and case-hardened, and we all know it is difficult to "teach an old dog new tricks." While many of us are far behind you in the

ATLAS

Guaranteed to be Superior to any Imported Cement.

Portland Cement

Used Exclusively in the American Surety Building, Johnson and St. Paul Buildings, New York Central Railroad Bridge over Harlem River, Equitable Life Insurance Additions.

ATLAS CEMENT CO.,
143 Liberty St., NEW YORK.

"technical and scientific knowledge of the day," it is to be hoped that a word of timely advice from the old pioneers may not be unkindly taken.

Finally,— transposing a line of Pope's,— the young engineer should be "the noblest work of God, an honest man." I have found among these older members here the salt of the earth, and you should strive to imitate the character of the purest and best among them, and while so doing, remember these lines from Bobby Burns : —

> "To catch Dame Fortune's golden smile, assiduous wait upon her,
> And gather gear by every wile that 's justified by honor,—
> Not for to hide it in a hedge, nor for a train attendant,
> But for the glorious privilege of being independent."

OUR ABSENT MEMBERS.

MR. HUBBELL.

Our absent members may be compared to latent heat, although not sensible of them, we know they are a part of us, and we are very glad to feel that they are a reserve force. I am not attempting to apologize for our absent members. Many of them stand responsible for the well-being of large interests, both public and private, and as the time of the year draws near when the cock croweth all night, they find themselves engaged in the preparation of annual reports of the business for the year past. I dare not pursue this line of thought further, lest it should be made to appear that those who are present are the weaklings among us, and those who can be best spared from the haunts of industry.

Our absent members : They are of us, and we all feel we would be greatly pleased and benefited if they were with us.

Vitrified Pipe vs. Brick Sewers

We make a specialty of large sizes of
vitrified, salt-glazed,

STANDARD CULVERT PIPE,

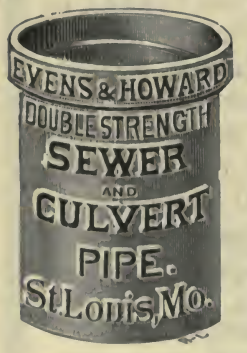
27-inch, 30-inch, 33-inch, 36-inch, for use in place of brick sewers, and for

CULVERTS UNDER RAILROAD TRACKS.

It is cheaper than brick or stone masonry,
and better than either.

SEND FOR PAMPHLET.

Blackmer & Post Pipe Co., St. Louis, Mo.



EVENS & HOWARD

Fire Brick Co.,

Manufacturers of

Fire Brick, Buff and Mottled Building Brick, Architectural Terra Cotta, Sewer Pipe, and other Clay Products.

Catalogs and Prices on Application.

920 Market St., - St. Louis, Mo.

THE UNITED STATES DEPUTY SURVEYOR AND HIS EXPERIENCES.

DORR SKEELS.

If I did not hate to talk of myself I could make this quite interesting. I don't know that there is any one present who has taken his grip upon his back and gone into the woods and put in six months there upon government surveying, but myself. Perhaps there is. Come into camp at night with the lobes of your ears extended about an inch, so that when you move your head in this way they flop against your face; your face stained with blue mud and the bites of the beautiful mos quito and fly; one eye closed, and the other nearly so; mouth drawn away so that you have to whistle cornerwise. We have experienced it. You all know that I am a noted swimmer. In projecting our survey we came to a part of a lake, which was four or five chains across the neck. We wanted to be on the opposite side of the lake on our line. As a matter of course I was the one to strip off my clothing, tie it in a bundle, put it on my shoulders, and start across. The water was pretty cold. I got pretty nearly across, and coming to a cut-off, I thought it would help me to shore. I started in there. I had n't gone a great way before — if I may be allowed to say "legs" — my arms and legs were all entangled with lily pads, entirely bound around, so that every stroke drew me into the water. I tried to keep my clothes dry. I was n't so particular about myself. But one stroke pulled me, clothes and all, under. I succeeded in getting back, and went around to shore and set myself up as a target.

At one time I was locating land. You know if you are in the shelter of a tree when it rains and thunders, you feel more safe, and the water which gets upon you is not so wet as when you are out in the open. Coming into camp one night pretty near dark, in one of those showers peculiar to the northern

GEO. N. SAEGMULLER,

SUCCESSOR TO FAUTH & CO.,

Washington, D. C.

MANUFACTURER OF

Astronomical and Engineering Instruments.

We call special attention to our newly improved Engineers' Transit, with bevel limb graduation.

This instrument cannot be excelled for accuracy or convenience.

Send for catalogue.

BUFF & BERGER,

No. 9 Province Court, BOSTON, MASS.

Improved Engineering and Surveying Instruments

They aim to secure in their instruments: *Accuracy of Division; Simplicity in Manipulation; Lightness Combined with Strength; Acromatic Telescope, with High Power; Steadiness of Adjustment under Varying Temperatures; Stiffness to Avoid any Tremor, even in a strong wind; and thorough workmanship in every part.*

Their instruments are in general use by the U. S. government engineers, geologists, and surveyors, and the range of instruments as made by them for river, harbor, city, bridge, tunnel, railroad, and mining engineering, as well as those made for triangulation, or topographical work, and land surveying, etc., is larger than that of any other firm in the country.

ILLUSTRATED MANUAL AND CATALOGUE SENT ON APPLICATION.

BIG MOUNTAIN MINING CO.,
VIRGINIA MINING CO.,

Miners and shippers of West Virginia Splint, Pumpkin Hill, and Cedar Grove

COALS.

Standard of purity, free-burning and low in ash.

Mines located at Cedar Grove, West Virginia.

Write us for delivered prices.

H. H. HEINER, Gen'l Sales Agent,

824 Spitzer Building. Toledo, Ohio.

Civil Engineering Taught by Mail.

Thorough courses in Bridge, Railroad, Hydraulic, and Municipal Engineering. Studies carried on at home, under the direction of able instructors. Specially prepared Instruction and Question Papers and Drawing Plates, bound in half leather, and fully indexed for convenient reference, furnished. Endorsed by engineers and the leading technical papers.

Also courses in Steam Engineering, Electrical or Mechanical Engineering, Refrigeration, Chemistry, Mining, Architectural or Mechanical Drawing, Surveying and Mapping, Sanitary Plumbing, Architecture, Sheet Metal Pattern Drafting, Prospecting, Bookkeeping, Shorthand, English Branches.

Circulars containing full particulars, sample pages of papers, specimen drawing-plates, and testimonials, will be sent free.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS,

ESTABLISHED 1891. BOX 1138, SCRANTON, PA.

part of the State, I got to a large pine-tree close by, and stayed there a while. Out a few rods were some beech-trees with limbs hanging down, and I thought that would be a better place. I started on the run. Just as I got squared away, lightning struck the pine-tree that I had just left, and broke it all to pieces. It came down in a pile. I started to run to camp, stumbled on a root, and pitched down on to the ground. Just as I started up, a dead tree came down right where I would have been if I had n't stumbled. When I stubbed my toe, I said, "Damn the root!" When I raised up and saw the tree come down, I said, "Thank the Lord!"

Another instance if I am not trespassing —

Mr. Wells: Go ahead, a surveyor can't trespass.

Mr. Skeels: We moved camp one Sunday evening, a rather sultry evening after a fine day. Just at the corner of the camp was a tree thirty inches in diameter. We were accustomed to drive pegs in such a tree to hang clothes on. We had got that done, and the washing and mending done, and dinner done, and had just set down for our usual Sunday talk, when the cook stuck his head into the tent opening, and said, "You fellows had better come out and get in your things, there is a mighty roaring out west."

We stepped out, and there was a good deal of a roaring, it was getting more roaring all the time. We gathered up our bedding and clothing and took it into the tent, got the door closed, and the rain and hail struck the tent, and the thunder kept growing more severe. A tree came down from the northwest and struck the large tree at the tent, which stopped the force of it, and it fell to the ground. One came from the west and lodged into the tree, another from the southwest came and struck it, and knocked it down in front of the tent. About a chain and a half south of us was the north side of where the cyclone passed, and the cyclone at that place was probably about fifteen chains wide. Perhaps some of you have been over the ground where one of these instruments has passed. There was hardwood timber thirty inches in diameter twisted off close to the ground, and up a distance of thirty feet, torn

NATIONAL

Wall Coping Hollow Building Blocks.

BETTER AND CHEAPER THAN STONE.

The National Sewer Pipe Co.,

General Offices, Barberton, Ohio,

MANUFACTURERS OF

AKRON STANDARD SALT GLAZED SEWER PIPE.

Quality the Best.

DISCOUNTS with the MARKET.

When answering advertisements, please mention "Michigan Engineers' Annual."

out by the roots and set on its top. Nothing standing had any top to it. After the storm ceased, we opened the tent, and cut a hole out from the trees which came on to us. Our friend Appleton might call that Providence.

THE LADIES.

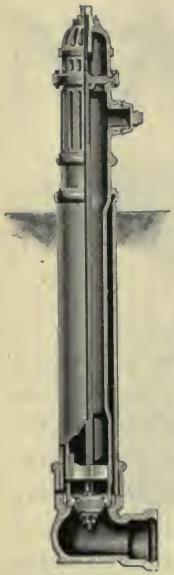
COL. E. W. MUENSCHER.

When I received that letter informing me I was to respond to this toast, I concluded that there had been a great mistake somewhere,— that through some inexcusable blunder of the typewriter, that letter had been put into the wrong envelope. But I examined it more closely, and found that there was my name in great clear letters stretching clear across the page, as it generally does when any one attempts to write my whole name. Well, I concluded that was the same mistake.

I don't think there is a member of this society who knows less about this subject than I do. I have lived with one wife some thirty years, and I have two grown-up daughters; but the longer I live with them the less I know on this subject.

I sat down to conjecture some reason why I was selected, and finally I came to the conclusion that the president had selected me because, knowing that I knew but little on this subject, it would take but a short time to tell it. After coming to that conclusion, I determined to have my revenge, so I sat down and wrote out a long, beautiful, eloquent speech. I know it was beautiful and eloquent, because after I finished reading it over, it was with greatest difficulty that I could restrain my tears. I am afraid some of the rest of you will find it as hard to restrain yours before I get through.

After completing the speech I put it in the safe, guarded it by two Yale locks, four bulldogs, and a beautiful engraving placed over the top, "Thou shalt not steal." I felt assured that would be safe. But just as I was going to leave for this occasion I went to open the safe, and to my great consterna-



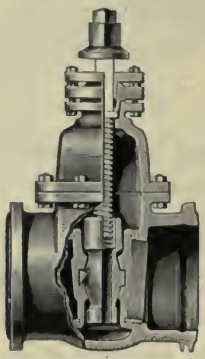
Mathews' Fire Hydrant.

R. D. WOOD & CO.,

Philadelphia, Pa.

CAST-IRON PIPE, SPECIAL CASTINGS, SUGAR-HOUSE WORK, GAS HOLDERS, AND MACHINERY.

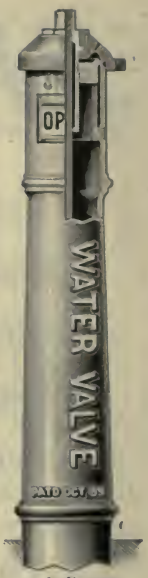
Circulars and Price-Lists on Application



Eddy Valve.

Constructors of

Water and Gas Works.



Indicator Valve Post.

WE MANUFACTURE

Cedar Paving-blocks, Cypress Paving-blocks, and sell to Cities and Contractors.

WE BID

On Brick Pavements, Wood Pavements, Macadam, Gravel, or Asphalt. We request notices of proposed street improvements, from civil engineers and city officials.

THE TALBOT PAVING COMPANY,

12 Jones Building, DETROIT, MICH.

Do you wish to join

The Michigan Engineering Society?

Write for a copy of the Constitution and By-laws to

F. HODGMAN, Secretary,
CLIMAX, MICHIGAN.

tion I discovered the office cat had eaten the speech. That same cat has eaten all my best speeches, and that is the reason you have never heard any of them.

I want to speak just one word seriously. I think every member of this convention will acknowledge, either now or sometime, that all our efforts are really for some woman. We may talk about working for honor, for money, for credit; but in the end, sifting the matter down, we are working for some woman. Somewhere, in some home, there is a wife around whom all our efforts center,— perhaps a daughter for whom we are laboring, laying up what little we can save from the expenses of the day, and hoping that her future lot may be a little brighter, a little less surrounded with difficulties and dangers, than ours has been.

Thomson Meter Co.

WATER METER MANUFACTURERS,

79-83 Washington Street, Brooklyn, New York.

Water Meters sold and delivered in 1897 - - - 16,115
Increase over 1896 - - - - - - - - 659

WE STAMP OUR METERS ONLY AS WE SELL THEM.

Whole number of Meters sold to March 8, 1898, - 108,439

CATALOGUE AND PRICE-LIST FURNISHED ON APPLICATION.

When answering advertisements, please mention "Michigan Engineers' Annual"

THE MICHIGAN

ENGINEERS' ANNUAL

CONTAINING THE

PROCEEDINGS OF THE MICHIGAN ENGINEERING SOCIETY FOR 1898

PUBLISHED BY THE SOCIETY
F. HODGMAN, SECRETARY, CLIMAX, MICH.

COPYRIGHTED IN 1898 BY THE MICHIGAN ENGINEERING SOCIETY

PRESS OF THE REVIEW AND HERALD PUB. CO.,
BATTLE CREEK, MICH.

MICHIGAN ENGINEERING SOCIETY.

OFFICERS FOR 1898.

President, Frank F. Rogers, - - - - Port Huron

Vice-President, J. J. Hubbell, - - - - Manistee

Secretary and Treasurer, F. Hodgman, - - - Climax

DIRECTORS.

Dorr Skeels, Grand Rapids, Wm B. Sears, Saginaw, E. S.,

C. E. Greene, Ann Arbor.

MICHIGAN ENGINEERING SOCIETY.

ANNUAL CONVENTION AT PORT HURON, DEC. 28, 29, 30, 1897.

ENGINEERS' PERSONAL FINANCES.

GEO. L. WELLS, BAY CITY, MICH.

My excuse for writing this paper, if an apology is needed at all, is this: During the last seven or eight years, I have had unusually good opportunities to become acquainted with engineers over a wide territory, and have been much impressed by the large number of men who are past the prime of life, who have spent all their working years in the profession of engineering, and who still feel the stern necessity of constant exertions for their daily bread. We may be pardoned, then, if we should spend a little of our time at the convention, and devote some space in our Annual, to the discussion of a subject for our own personal interests.

The proverbial modesty of engineers extends even to their fees and salaries. While the surplus, or profit of their incomes left for investment for "rainy days" and declining years, is small, the problem of investing it safely and profitably is none the less perplexing.

Small investments, unless made with the security of real-estate mortgages, require almost constant watching. A small investment in a business venture is liable to come under the management of a man without the necessary talents or experience.

It is often enticing to a small investor to unite fortunes with an inventor, when it is shown so plainly that a small sum

will put the invention on the market, and enable the investor to reap a big profit. When a beautiful illusion is made to seem so real, a person is likely to forget that it generally requires as much business skill as inventive genius to make a new device a commercial success, and keeps his mind's eye on the formula for computing profits used by Dr. Seller's when he was ready to market his eye-salve.

The opportunities to make small investments are various. The ways in which they can be lost are estimated to be much more numerous, because an opportunity is like a skimmer, in that it has more holes in it than any one supposes until they are actually counted.

The secret of so many losses in small enterprises is, as said above, that the investor cannot give the matter his own watchful care. The situation of engineers with reference to winning success by investing in a small way, is particularly unfortunate. Their time is almost wholly occupied on public works or large enterprises of others. They change their places of residence frequently in following up new works, so that it is a difficult matter for them to give much, if any, time to watching an investment of their own. But an accumulation of small investments makes large ones, to the care of which the most experienced and skilful business management is brought.

The large life insurance companies are monuments of the success of mutual and co-operative investments of an accumulation of small sums of money. They have been the most prominent institutions which have invited the savings of people with moderate incomes for profitable returns, and with results that have been generally satisfactory.

Building and loan associations, while not entirely modern, have not operated much in this country until quite recently. They began with considerable activity in this State ten or twelve years ago.

They are of two general classes: Those doing a business over a large territory, and styling themselves "national" or "state," and local building and loan associations, doing a

loaning business only in the city or county in which their office is located.

While no general statement can be made regarding the integrity of the management of either kind, yet it can be said without fear of contradiction that more dishonest schemers and irresponsible adventurers have organized building and loan associations of a national character for fraudulent or dishonest personal ends, than has ever been the case with local building and loan associations. It will take but a little investigation to satisfy any one that the expense of conducting a national building and loan association is greater than in a local one. These statements are not made as an attack upon national associations. There are honestly conducted national and state associations, and there is no absolute guarantee that dishonest men will not be connected with the management of local companies. But in presenting this matter it is only proper to mention whatever experience has shown to be true.

The first annual report relative to building and loan associations doing business in the State of Michigan for the fiscal year ending July 1, 1896, has been compiled under the supervision of the secretary of state at Lansing. This report gives a very comprehensive statement of all the companies in the State, and would aid an investor in making a selection.

For the purpose of illustrating the advantages of investing in local building and loan associations, two of them, one at Grand Rapids, the other at Bay City, will be discussed. The Grand Rapids association was incorporated in March, 1888, and the Bay City association in October, 1887. The shares in each are $100. The weekly instalments of the Grand Rapids association is 15 cents a share, and in the Bay City association it is 12½ cents. It was estimated in both cases that they would mature their stock in eight years. At the first of the year 1893, the affairs of the Grand Rapids association indicated that the stock would be matured in less than seven and a half years; but the hard times that came upon the country in that year had a depressing effect upon this as well as many other financial institutions. It paid out its first stock, or rather

matured its first series of shares, in eight years and five months. The Bay City association matured its first series of shares in nine years.

With the hard times that every one experienced after 1893, it would seem to be safe to take the experience of these associations as what can be reasonably expected of them in the future. Below is an estimate showing what results can be derived by taking ten shares (which will mature into $1,000) in each of these companies, and keeping all proceeds invested, so that the interest from them will keep up new stock. Now, suppose that at the end of a maturing period, $1,000 is drawn from the association, and it is desired to keep all this money at work in keeping up new stock, besides what is being kept up from the weekly payments. In the Grand Rapids association it takes $52 \times \$1.50 = \$78$, and in the Bay City association it takes $52 \times \$1.25 = \$65$ a year; hence, in order to have a thousand dollars matured from the interest earned by the $1,000 drawn from the association, it will be necessary to lend it so that it will net 7.8 per cent. per annum to mature ten shares in the Grand Rapids association, or to net 6½ per cent. per annum to mature ten shares in the Bay City association.

A dollar and a half a week paid to the Grand Rapids association with the money drawn on matured stock invested as stated above, is estimated to give the following results: —

PERIOD.	Amount to be derived from $1.50 weekly instalments.	Amount invested at 7.8%, which is the total amount on hand at end of last maturing period.	Amount to be derived from the association from stock matured from interest as stated in last column.	Total.
8 years, 5 months.....	$ 1,000			$ 1,000
16 " 10 "	1,000	$ 1,000	$ 1,000	3,000
25 " 3 "	1,000	3,000	3,000	7,000
33 " 8 "	1,000	7,000	7,000	15,000
42 " 1 "	1,000	15,000	15,000	31,000

One dollar and twenty-five cents a week paid to the Bay City association, with the money drawn on matured stock invested as stated above, is estimated to give the following results:—

PERIOD.	Amount to be derived from $1.25 weekly instalments.	Amount invested at 6½%, which is the total amount on hand at end of last maturing period.	Amount to be derived from the association from stock matured from interest, as stated in last column.	Total.
9 years	$ 1,000			$ 1,000
18 "	1,000	$ 1,000	$ 1,000	3,000
27 "	1,000	3,000	3,000	7,000
36 "	1,000	7,000	7,000	15,000
45 "	15,000	15,000	15,000	31,000

As these tables are estimates for ten shares, it will be at once apparent what results can be derived from investing any multiple of $1.50 or $1.25 a week. For instance, a young man twenty-five years of age, starting to invest $6 a week in accordance with the above plan in the Grand Rapids association, will have $28,000 when he shall have attained the age of fifty years. Or if he invests in the Bay City association, he will have $33,600 when he shall have attained the age of fifty-two years. Where are the engineers who have devoted from twenty-five to twenty-seven years to hard work in the profession who can show a like amount?

There has been much said of the fickle goddess fortune; but the vacillating plans of the seeker of fortune is more to blame than any capricious actions of this charming deity. An analysis of the fortunes of most men shows that they followed up some plan with unyielding pertinacity. "Oh! a plodder!" some one will say. Yes! a plodder if any one chooses to call an accumulator of this kind such. They were plodders whose thrift built up the fortunes and developed the magnificent manhood of New England — the manhood which put New England in the lead of all the world.

When an untaught German, whose greatest genius was to raise a cabbage that took the prize at the county fair, or an illiterate Irishman, had been able to accumulate a fortune which makes men of much culture almost envious, it leads one to think that the formula for working out a fortune is much more simple than any expressed in higher mathematics. The plan and formula must both be simple — the only difficult part is to *keep everlastingly at it.*

The plan presented here for providing an opulence for old age is not the only one. It will not get along without some care and prudence on the part of investors. But the plan of operating local building and loan associations, managed, as they are, by a board of directors of the leading conservative and experienced business men of the community in which they are located, and with funds invested on real-estate security, seems to be one particularly well adapted for engineers' savings institutions.

So far the discussion has been to show the *individual* advantage to be gained from a fixed plan of investment. There must be a great advantage to the profession if its members are in easy financial circumstances. Fees and salaries are fixed by competition, view it as we may. Human nature in engineers is the same as in other mortals; and when dire necessity is prodding an engineer, his competition is much sharper than it would be otherwise.

One more advantage in the use of building and loan associations will be given; then I will close. The popular use of investment insurance has been referred to. Good as have been the results from that form of investment, they can be improved by dividing the premium into two funds, buying term insurance with one, and investing the other in building and loan stock.

To illustrate: One of the stanchest old line companies issues a twenty-payment life accumulated surplus policy for an annual premium of $30.41 per $1,000 indemnity at the age of thirty, upon which the guaranteed reserve is $482, and surplus estimated at $360, making an estimated withdrawal value at

the end of twenty years of $842. The same company issues a twenty-year convertible term policy for $14.35 premium a year for each $1,000 indemnity at the age of thirty, upon which the only return in case of survival of the twenty-year period is whatever can be saved in the management. This would be quite small in any event, and will not be considered here. It might also be stated that this company will allow the holder of the term policy to reinsure without physical examination at the end of the twenty-year period, or to change to any other form of insurance during the time the policy is in force. A $5,000 policy at $30.41 a thousand will call for an annual premium of $152.05. A $5,000 term policy will be $71.75, leaving $80.35 to be invested in building and loan stock. Now $78 a year will mature $1,200 in nine years in the Bay City association, or $1,000 in the Grand Rapids association in eight years and five months. This will allow a $5,000 twenty-year term policy to be carried, and stock to the value of $4,320.96 to be accumulated in the Bay City company, or stock to the value of $4,143.60 to be accumulated in the Grand Rapids company at the end of the twenty-year period, and at an annual cost of $149.75, or $2.35 a year less than the twenty-payment accumulated surplus policy costs.

The following table will show the advantage of dividing the fund, and buying insurance pure and simple, from the insurance company, and investing the other part in building and loan stock.

This table shows a comparison at the end of each year for twenty years of the benefits to be derived by a dependent family by investing $152.05 all insurance, and by dividing this amount as nearly as may be, and investing in $5,000 term insurance and balance in building and loan stock.

YEAR.	Cost, $152.05 per annum for accumulated surplus policy. *	Cost $149.75 Per Annum. †		
	Amount paid to estate at death.	Term Insurance costs $71.75 per annum. Amount paid to estate at death.	Twelve shares of Bay City building and loan stock costs $78. Value at end of each year by above plan.	Amount realized by estate at death from term insurance and building and loan stock.
One	$ 5,000	$ 5,000	$ 84 24	$ 5,084 24
Two	5,000	5,000	180 24	5,180 24
Three	5,000	5,000	289 50	5,289 50
Four	5,000	5,000	408 78	5,408 78
Five	5,000	5,000	539 60	5,539 60
Six	5,000	5,000	682 14	5,682 14
Seven	5,000	5,000	836 64	5,836 64
Eight	5,000	5,000	1,000 08	6,000 08
Nine	5,000	5,000	1,200 00	6,200 00
Ten	5,000	5,000	1,368 48	6,368 48
Eleven	5,000	5,000	1,560 48	6,560 48
Twelve	5,000	5,000	1,779 00	6,779 00
Thirteen	5,000	5,000	2,017 56	7,017 56
Fourteen	5,000	5,000	2,279 20	7,279 20
Fifteen	5,000	5,000	2,564 28	7,564 28
Sixteen	5,000	5,000	2,873 28	7,873 28
Seventeen	5,000	5,000	3,200 16	8,200 16
Eighteen	5,000	5,000	3,600 00	8,600 00
Nineteen	5,000	5,000	3,936 96	8,936 96
Twenty	5,000	5,000	4,320 96	9,320 96

* The total estimated value of this policy at the end of twenty years is—

Guaranteed Reserve	$2,410
Surplus (estimated)	1,800
Total	$4,210

† The value of the investment in Bay City building and loan association stock would be $4,320.96 at the end of twenty years, and $4,143.60 in the Grand Rapids association. While the money drawn at the end of the period is not a great deal different from that drawn from the insurance company if the insured investor survives the twenty-year period, yet the protection afforded to the estate or dependent family increases with time, as shown in the last column. Besides this advantage, in case of adversity under this plan, money would be on hand not only to pay premiums but to live upon. Again, in this particular comparison the $2.35 difference saved would more than pay for the extra insurance for the return of premium in case of death, which would increase the indemnity by $28.70 annually.

Mr. Williams: I want to say a word or two in regard to the compensation of engineers and incidentally in regard to the relations which should be borne by one engineer toward another. Possibly, more than we realize, those who are filling positions upon a salary, are responsible for the lack of work of those who are not. It is not infrequent that men come to our office, to get, in a few moments' conversation,—or possibly a longer one,—information, which thereby deprives some engineer of a legitimate fee. It is not infrequent that we are placed in a position where we are asked to advise people, and our usual inclination is to say: "Oh, well, we are paid a salary anyway, and if this thing is any good to you, take it." I think nine out of ten of us are inclined to give such services without asking compensation. I want to say that the duty we owe the profession is to charge a higher price, if anything, than if we were in private business; not for our own good, but because we are working upon a salary and have something upon which to live, and we should not be drawn into competition with those men who are working for theirs but do not have the salary. I say to you that the proper position to take, if you are asked for an opinion, is to insist upon being paid for it in every case. I myself stick on about as high a price as I think anybody can stand. I say, "If you have an idea that you can get this more cheaply out of me than out of a fellow maintaining an office and getting his living in that way, you are mistaken. If you want me, you can count on paying me a little more than you pay the other fellow." I don't know as a result that I get very much consultation, and I don't have time for very much of it. But I have a feeling that I am not taking the bread out of the mouth of a man working for his living under less easy conditions than I am.

Another thing I want to say. Some of us stand higher in the profession than others do, and we should be careful how we enter into competition with one another. If we see that some man has a little better chance than we have of securing certain work, I think it is proper to drop out and let him have it, and stop this everlasting cutting of prices and working against

each other for jobs. I think that is the feeling that should be maintained among engineers. I say, since we are professional men, we have no business to go into a bidding scheme against one another. We have no business to try to cut out a man who has a hold upon a piece of work. I think we should stand off and say, "Here is our price; if you want our services, we will do it for this price," and if some one else is successful, we should be ready to say a good word for him if he deserves it. If he is a fraud and an impostor, give it to him for all you are worth.

Mr. Riggs: I am very glad that Mr. Williams got up and said what he did. I think one thing might be added, and that is this: there is, perhaps, too large a tendency on the part of those who are in the profession as consulting engineers, to try to get a piece of work — to take it away from competent local men. I have given this matter of engineering ethics some little attention, and I believe that our profession will not get any nearer a system of engineering ethics than an application of the golden rule. I think when I am after a piece of work, and I find a competent man there, it is not right to take the work away from him. If he wants any help, any assistance, then you can render it to him in the consulting capacity. Go into the field for that, but don't try to take away work from a competent local man. The local man should not feel that it is a disgrace to call upon a specialist. I believe there ought to be more change of work between the city engineers and those outside; there ought to be less feeling on the part of the city engineers that they want all the work to the exclusion of local men.

Mr. Williams: In regard to how far members of the profession should go in giving information to other members, I would say that it depends on your relations with the other member,—how much have you got out of him? what will you get out of him in the future? In general, I would say, when you have no relations with him and don't know him, "If you want this, pay for it." If he is a gentleman with whom you have relations, that is a personal matter, and nobody's business, and you charge him or not as you see fit.

THE SEWERAGE OF PONTIAC.

H. E. RIGGS, TOLEDO, O.

The question of the sanitary value of a complete system of sewerage in a community does not have to be argued against such strong opposition as a few years ago. The construction of the Memphis system by Colonel Waring was followed, as many of you will recall, by the most violent criticism even from sanitary engineers; but the experience of the past two decades has won the greater part of the engineering profession to the separate system of sewerage, and has overcome the prejudices of the lay members of various boards and councils, so that to-day the sanitary engineer finds but little difficulty in securing the adoption of the separate, or "sanitary," system.

It is the writer's intention briefly to outline the history of the efforts of the citizens of Pontiac to secure a system of sewerage, to describe somewhat in detail the plans finally adopted and some of the methods of construction used, and to submit for your consideration some opinions of the writer deduced from this work and other works of the writer, which may to some extent differ from general practise.

Pontiac is the county seat of Oakland county, and was settled very early in the history of the State. Its population in 1890 was 6,743. Present population is probably about 8,000.

The assessed valuation in 1893 was $2,421,805. The total bonded debt, including water-works bonds, was $85,000; school bonds, $12,000; floating indebtedness, about $3,000; sewer bonds, issue of 1895, $25,000.

The matter of the construction of a system of sewerage was under discussion for some years prior to 1893, but no definite action was taken until 1891 or 1892, when W. S. Parker was engaged to prepare plans for a system. He submitted a set of maps and profiles, providing for an outlet into the Clinton River some 3,000 feet below the present outlet, and providing for two main sewers of brick, one on each side of the river.

The lateral system was on the lines of the separate system, 6-inch pipe being the smallest size provided for laterals.

Considerable discussion followed the adoption of Mr. Parker's plans; and, owing to the topography of the city, the river flowing by a very devious course through it, cutting it into two nearly equal parts, a considerable sentiment developed against the construction of the proposed mains, and favored emptying direct into the river, and cleaning and straightening the channel of the river, and removing a mill-dam in the heart of the city.

This sentiment resulted in the council's calling on Prof. Chas. E. Greene, Mem. Am. Soc. C. E. in 1893, to report on the proposed scheme of river improvement, and on the plans for sewerage as prepared by Mr. Parker. In a valuable report dated Oct. 30, 1893, he advises against the use of the river as proposed. First, on the grounds of the unsanitary conditions likely to be brought about by the pollution of so small a stream, the flow being from 2,000 to 3,000 cubic feet per minute, and the velocity about 1½ miles per hour. The condition of the river during the past few months at Huron street and near Paddock street has been such as to prove to any one that Professor Greene was right on this argument. A second reason brought out in the report in favor of a system of sewerage was that the estimated cost of cleaning and straightening the river and purchasing the dams was about $30,000, while he estimated that all the main sewers could be built for less money.

As the actual cost to the city of the main sewers, including all expenses of commission engineering, etc., was less than $28,000, subsequent events have borne out the report.

Professor Greene recommended some changes in the plans of Mr. Parker, and urged the adoption of the separate system.

One short 6-inch lateral was built on Mr. Parker's plans, and the matter of sewerage was dropped.

In 1895 a sewer commission was appointed and plans discussed. Mr. Geo. S. Pierson, Mem. Am. Soc. C. E., was called and reviewed Mr. Parker's plans. He called attention to an error in levels made by Mr. Parker, which caused a much less

grade on the main outlet than had been shown, and after an examination of the ground, recommended some radical changes in the line of the main sewers.

The most notable point about Mr. Pierson's report is the almost prophetic paragraph, calling attention to the probability of encountering water in excavation and recommending underdrains, and further recommending full examination by test pits and otherwise.

Immediately after Mr. Pierson's report was received, the board proceeded to appoint as engineer of the sewer system, Mr. Geo. A. Nettleton.

He made surveys and made a plan and profile for a main sewer, adopting the suggestions contained in Mr. Pierson's report. The plan did not show any laterals, and no tributary territory was surveyed, it probably being intended to connect up the lateral system shown by Mr. Parker. The main sewers were advertised, and the contract was awarded to Peterson & Burd of Bay City, on a lump-sum bid of $16,374.19.

Construction was commenced late in the season of 1895 and some 1,800 feet were built before winter closed in.

In the spring of 1896, Mr. Nettleton having during the winter accepted another position, work was opened with H. E. Terry as engineer. From April 1 to August work dragged, many difficulties being encountered and frequent changes of engineers, four men following one another in rapid succession.

On September 1 the writer took charge of the work. The condition at that time was anything but encouraging. The removal of a local engineer by the board had caused a division of feeling among the citizens which made the work anything but attractive. The contractor had already run 30 days past the time limit of his contract, and had just about one third of the length of sewers contracted for, built. He felt that he was losing money and was thoroughly discouraged by unforeseen difficulties; and further, the sewer already built had an immense volume of ground water running in it; at one point the 20-inch pipe was running nearly a third full.

Our special attention was given to pushing the work; an increased force of men was put on and the work rushed day and night, when any progress could be made by night work.

When the time for the first estimate came around, a new difficulty was encountered, as the contractor was unable to carry the work without an estimate, and under the contract he had hardly enough due to meet his labor. October proved a good month, and in November affairs were in such shape that were the work abandoned the city would not be involved, so we demanded a full observance of the contract before closing down for winter. The contractor decided to abandon the work, and left town. A delay of a few days was occasioned, financial matters were straightened up, and the contractor again took up the work. On December 24, we closed down, having all the work done excepting 2,400 feet on one branch main.

April 1, 1897, work was resumed, but difficult ground and other delays caused the contractor to fall so far behind that in June the contract was declared forfeited, and the city took charge, the engineer completing the work and making repairs. Work on the original contract was practically done July 1, but extensive repairs delayed acceptance till August 1.

It was found necessary to take up about 100 feet of pipe laid in June, 1896, as the pipe had crushed. The depth of fill at that point was 20 feet, and it appeared evident on excavating it, that the crushing was wholly due to an extremely narrow trench and consequent lack of packing of earth under the pipe. The writer was informed that much difficulty had been experienced in the first place in this locality on account of caving, which probably would account for the narrowing of the trench. The material was sand for the entire depth.

In the autumn of 1896, after the writer took charge, an examination of the plans of Mr. Parker was made. It was found that details were sadly lacking, and also that, owing to the change of line and grades of the main sewer, it would be well-nigh impossible to connect the two sets of plans and make anything but a botch job. The writer recommended abandoning entirely the Parker plans, and the preparation of a new and

complete set of plans based on the main sewer as constructed. In March, 1897, the work was decided upon and this work which should have been the initial step, was commenced after nearly all the main sewer was in. It was completed and a full set of plans for laterals submitted on Sept. 1, 1897. Only a small part of the lateral work has been done this year.

The main sewers have cost the city considerably more than the contract price by reason of the wet work and the quicksand; but on the whole the cost was very low.

The original bids received were—

NAME.	LABOR ONLY.	LABOR AND MATERIAL.
Liphardt & Winterhalter, Detroit	$10,823 00	$19,817 00
Lennane Bros. & Co., Detroit	18,249 50	41,889 50
W. H. Osmun, Jr., Pontiac	15,267 00	22,509 00
Jaynes & Mercies, Detroit	21,976 00	30,703 00
John Wagner, Detroit	14,511 50	21,377 50
*Peterson & Co., Bay City	8,067 65	16,374 19
J. J. Granville, Saginaw	13,605 00	22,850 00
John Jeynes & Co., Detroit	20,507 00	29,305 00
Patrick Dee, Detroit	14,533 00	24,939 00
F. W. Glanfield, Ypsilanti	17,238 44	27,309 20
Harding & Shafer, Detroit	16,619 79	26,605 00

*Awarded Contract.

The cost of the sewers complete are as follows:—

Contract—	2,250 ft. 24″ pipe.	(1 River Crossing)	$1.71 8/10	$3,845 00
	3,675 " 20″ "	(2 " ")	1.53 4/10	5,638 35
	1,908 " 18″ "	(2 " ")	1.31	2,505 98
	1,648 " 12″ "		.55 7/10	917 94
	1,814½ " 12″ "	(1 " ")	.64 7/10	1,173 98
	3,247 " 12″ "	(2 Creek ")	.65 11/100	2,114 05
	300 " 10″ "	(1 River ")	.70 1/10	210 36
Total under original contract				$16,405 66

(The slight increase in price was due to a small excess in length over schedule lengths.)

Supplementary Contract, increase of size of 3,247 feet 12″ sewer increased to 18″ sewer	$ 1,474 61
Extra Manholes and Lampholes	119 50
Extra Concrete and Brick	1,045 33
Extra excavation, Subdrains, and change of Cement, etc., etc.	311 94
Total of Final Est	$19,356 04

Payments were made as follows: —

Estimates to Contractor	$15,366 26
Labor after forfeit of Contract	2,041 14
Material " " " "	399 31
Total paid Excl. of penalty	$17,806 71
	19,356 04
Cash on hand to meet penalty	$1,449 33

Under the terms of the contract there was a penalty of $15 per day, the engineering and inspection expenses and the forfeiture of the entire 10% reserve. Had the strict interpretation of the contract been lived up to, the contractor would have owed the city $7,674.40.

While there was a disposition to be firm with the contractor, no effort to demand the "pound of flesh" was made, and the contractor's labor bills, amounting to about $600 have been ordered paid, leaving $800 to apply on over $1,800 engineering expenses.

The total cost of the main sewers was as follows: —

Advertising and Printing	$ 76 15
Expenses of Sewer Commission	106 25
Right of Way and legal	4,066 00
Miscellaneous Construction	347 29
Engineering and Superintendence	3,490 56
Contract	19,356 04
Total Cost	$27,442 29

or, including everything, $1.85 per lineal foot.

Although the work was delayed one year over the contract time, there was in the sewer fund enough money to complete the work, a shortage of $379.48 being made up by the sale of sand and gravel from land bought, and by funds paid in by the asylum for change of size so that there is a balance on hand of over a thousand dollars.

The work offered some very interesting problems. An inspection of the map will show a very rolling, broken country, with some sections along the river, and along Pontiac Creek, and in the upper part of town, lying very low. Hence some of

the cuts are very deep, the main sewer at Mill and Huron streets being 30 feet; and for a very considerable distance, cuts averaged over 20 feet.

Every variety of excavation was met with except rock. Blue clay, yellow clay, loam, marl, sand, gravel, boulders, and quicksand were found. There were seven river crossings and three creek crossings, the sewer keeping a continuous grade and being low enough to pass below the bed of the streams. Consequently, we had large volumes of ground water in some sections of the sewer.

When the writer took charge, the practise was to put cement in pipe, place next pipe, and cement up the joint. A loose hemp was used and none of the gaskets were sufficient to keep out water.

The cement used was Milwaukee, and it was evident that where water rose around the pipes the cement mortar disintegrated, leaving the joint open on the lower third of the pipe. Cement was changed and a mixture of Milwaukee and Lisbon quick-setting cement was adopted. The Lisbon will set in about five minutes under water, so that we had less difficulty after its adoption. After a few days we adopted cheese-cloth lapping, tearing off strips of cheese-cloth or sheeting nine inches wide, and after the joints were made, wrapping them and binding with cloth. The advantage of this is that although the water may rise to a considerable height behind the pipe layer, after back filling has commenced, the cloth will prevent the cement from dissolving out from the joint mortar until it has set.

In some sections, we encountered a very coarse gravel with boulders, with such a volume of water that the pumps could not keep it down. In such ground the water invariably rose in the sand, which was filled in over the pipe to a height of several feet and caused much trouble by following along the pipe and washing out our joints. We adopted a system of stringers and saddles for this work. Laying a 4″ x 6″ x 16′ stringer in the center of the trench with soft tile-drains along the sides, the pipe was carried on saddles, sawed from 2″ x 4″, the balance of

the space being filled with concrete to give the pipe a solid bed. In some sections, stringers were not required, but concrete alone keptout our ground water.

Where quicksand was encountered a double floor of planks and from 6 inches to 1 foot of concrete was used to secure an unyielding foundation. In one case such a floor was tested thoroughly: an 18-inch iron pipe of one-ton weight dropped, on account of the breaking of a chain, 16 feet, striking the floor squarely. No jar or displacement resulted although our coffer dams were holding back about 4 feet in depth of quicksand over the level of our floor. At the river and creek crossings, cast-iron water pipe was used, lead joints being made.

The contractor put in these pipes one at a time, damming the river and changing his dams as he required space. This was in the writer's opinion a more expensive proceeding than to have lowered several lengths together, but was due to lack of equipment.

A few words as to the lateral plans may be of interest. The surveys were made early last spring and work was carried on at the same time as the main sewer work, so that the writer was unable to give it undivided attention; hence the apparently longer time occupied.

A contour map, scale 300 feet to 1 inch, was made, and the general system planned. Details were made on sheets 18″ x 36″ with a border leaving 14″ x 34″ working space. Profiles were drawn to a vertical scale of 8 feet per inch with 100 feet per inch as horizontal scale of profile and plats.

Grades were shown, and full instructions as to manholes, flush-tanks, slants, Y branches, and all other appurtenances given, but no plus stations were indicated, all such details being left as a matter of construction records.

All drawings were made on mounted paragon paper, and substantially bound in heavy canvas-covered board with leather backs and corners.

A sectional atlas of the city, to a scale of 100 feet per inch, was also made, showing all water and gas pipes, sewers, old drains, and storm-water sewers, in addition to the new system.

This was not properly a part of the sewer plan, but was prepared for the Board of Public Works, who had the water-works in charge.

You will note that several different styles of drop manholes are shown.

It is the writer's opinion that such a construction can be used to very great advantage in a separate system of sewerage in any hilly town, such as Pontiac. There are many cases there where a drop of from 6 to 15 feet can be made into a main sewer or lateral, and save much in cost of construction of laterals and house connections. Then, too, I do not believe in using very heavy grades on sewers where there is quite a district beyond, as in a section of town where houses are scattered and the amount of sewage is not large, a grade of 5 or 6 feet or more per hundred will give such a small depth of flow that solid matter will have a tendency to lodge. Our maximum grade at Pontiac is 4%; our minimum on laterals 0.5%.

In towns having much ground water, underdrains along the line of the sewer will be found of great advantage during construction. We used 5-inch socket pipe, which we got for 2½c per foot, and which cost, laid, about 5c per foot. It did more in my opinion to obviate the evil of ground water in our sanitary sewer than any other measure that was adopted, and it was much the cheapest. In this connection I would say that I do not believe in the connection of cellar drains with such underdrains. I am aware that some of the best authorities in the country oppose connecting cellar drains with the sanitary sewers. This is a matter that I have examined into at every system of sewerage I have investigated, and I find: —

1. In nearly every case, cellar drains are connected with the sanitary sewers; and where they were not intended to be so connected, the connections are made without proper permission and inspection, and are a source of greater danger than where properly inspected and trapped.

2. Where the sanitary sewers are shallow and built without regard to the depth of cellars, it does not always bar the adjacent owners from trying to connect, and in some cases the

grades have been such as to cause a flow *into* the cellars with the least stoppage.

3. In several instances, in which underdrains have been built, cellar drains of soft tile have been connected, and later on bath rooms and kitchens have been connected with the underdrain, causing the very fouling of ground water that the underdrain is designed to prevent.

4. In every community the sewers are desired, by a large proportion of the people, for the purpose of draining cellars. Bath rooms and closets logically *follow* the construction of a system of sewerage, as far as a majority of the people of our smaller towns and cities are concerned. Hence, any system of sewerage not providing for cellar drains in sanitary sewers will not meet with general approval, as it means a double system of mains, laterals, and house connections in addition to any storm-water sewers that may be required.

5. The great danger in the use of open jointed pipe is that it will clog and choke with sand during construction. I have always found it difficult to keep drains open in sandy soil. To connect cellar drains to such pipes is almost certain to cause trouble from water backing into cellars.

If we would be consistent in our arguments, when we claim as an advantage of the separate system that the velocity and depth of flow secured by the small pipes, and the cleansing action of the flush tanks, prevent decomposition, and thus obviates the formation of sewer-gas, we cannot in the next breath advise against admitting cellar drains into the sanitary sewers on account of the increased danger of sewer-gas getting into the houses through cellar drains.

Further, admitting, as we must, that we will occasionally find sewer-gas in a separate sewer, there ought to be no more difficulty in securing as good a cellar drain as house drain. One can be trapped and ventilated as well as the other, and unless a system of inspection is in vogue, great danger may be looked for from poor house plumbing, no matter how well the sewerage system is built.

This is a matter that I believe ought to have the fullest dis-

cussion, as it is my opinion, and will be until I am convinced by argument, that the proper thing to do is to plan the sanitary system to carry off cellar drainage.

The argument has been advanced by an eminent sanitarian that wet cellars are only encountered in soil where the underdrain in the sewer trench is a necessity. That was not the case at Pontiac. We encountered all of our ground water in gravel and generally at a lower level than any cellars, but in passing through clay, we often passed within a few feet of, and far below, wet cellars and yet had no ground water. It is better to provide for these connections, regulate the manner of putting them in by ordinance, compel inspection by the engineer or officer in charge of sewers, and only allow them to be put in under a special permit, than it is to slide over the matter in the preparation of plans, and later have the question to settle.

The writer used clay to some extent to protect the cement from washing out after joints were made, and desires to call the attention of members to the fact that quite an extended discussion of the subject of the use of clay instead of cement for making tight joints, has been had by English engineers; and the clay is ably championed by Mr. R. S. Rounthwaite in a paper read at the Congress of the Sanitary Institute at Newcastle upon Tyne in September, 1896.

His reasons are: —

1. Damage to system by cement not being wiped from joints.

2. Liability of cement joints to break from being stepped on, or in back filling or pile sheeting.

3. We have no guarantee that weight of earth or unequal settlement does not break cement joints.

4. In case of fracture, leakage is sure to take place and must result in subsidence of pipes.

5. Difficulty of repairs.

6. Danger from using poor cement.

7. Clay will not fracture, will permit of slight yielding, and is easy to repair.

8. Clay is impervious and will prevent leakage.

No branch of engineering work has received any more attention during the past few years than sewerage, and great progress has been made in methods of construction of the system of sewerage itself as well as in the method of ultimate disposal of sewage. In spite of the increased knowledge, we still find towns and even some old cities going on with new work with ill-considered plans for a partial system or with no plans at all. I believe that I can safely say that the city of Pontiac has spent over $25,000 on "sewers" during the last thirty years that has been an absolute waste. There are miles of pipe which is filled up and is utterly worthless, but which with a little more care in construction might be serving a useful purpose to-day.

A properly prepared, carefully considered plan, with details worked out, ought to be the first step. Then the construction of a system is a matter of time, if every lateral is strictly made to conform to the plans. I do not mean by plans a mere map and outline, but *details*. They ought to be bound so as to be always an available record, and should be so made that all construction notes can be added. I see no more reason for putting from $50,000 to $100,000 into a system of sewerage without proper plans than of spending the same amount of money in a city hall or other public building and not employing an architect; yet it is frequently done.

There is no public work more important than the sewerage system and the system of sewage disposal. The time is near at hand when such work will be out of the hands of local boards and will be regulated by the State Board of Health in all our Eastern and Central States; and when that day comes, it will be hailed with joy by every man in the engineering profession who desires to do honest, legitimate, professional work.

Mr. Sears: You have not told us what you did with all this richness down at the end of the sewer.

Mr. Riggs: The present outlet of the sewer is about a quarter of a mile inside the east city limits. The sewer board owns

15 acres of land just below this, which is gravel land, and which will ultimately be used for the land disposal of the sewage. At present they are emptying the sewage into the Clinton River for the benefit of the people at Mt. Clemens, about 19 miles away.

Professor Davis: I think we deserve to felicitate ourselves upon the reception of information of this kind, that is in the shape in which we want it. It tells something. This paper contains a number of very useful suggestions. In Ann Arbor the sewers are planned without regard to draining the cellars. A great many people have their laundries in their cellars, and it always seemed to me that the grade of the sewer would of necessity be planned with respect to the cellars for the reason of draining the laundry tubs, if nothing more. A great many other people have water-closets in the basement, and it seems to me they should be taken care of, regardless of whether we were draining cellars or not. I saw an excavation being made the other day for the purpose of getting down to a branch curve connecting a house drain with the sewer. It was plugged up, probably with a wad of paper, an orange peel, banana skins, old shoes, and different things, which, you know, are cautiously and carefully inserted into the drainage system of a house. The man who had charge of it told me that he had already drawn back quite a portion of the plug by means of a wormer, such as we used to use to pull the charge from a muzzle-loading shotgun, but had broken off the iron rod in there; and now he not only had to get the plug out, but had to get out his fixtures. I wish to ask in that connection if a piece of flexible shafting could be used to follow around those turns and get at those plugs or paper wads.

Mr. Sears: I want to tell a little story about house drains. I found my cellar filling up with water, and made an excavation in order to flush out the pipe. The water backed up, and we had some difficulty; the water came with such force as to scatter all over. I procured a large gunny-bag, and gave it to the workman. He was to put his foot on that to prevent the water's scattering. I said: "Kelly, be sure and keep your

foot on that, for if you lose that bag it will be blocked sure." I had no more than said that before he lifted his foot and away went the bag into the sewer. The next morning I had to cut the street up and make an excavation 10 feet deep. In the ventilator at the street pipe, some rascal had dropped a stone, and we found the gunny-bag right against the stone. If it had n't been for the escape of the bag we would not have found the stone at all.

Two years ago our court-house in Saginaw was condemned as unsanitary. The health board got after us. It cost us about $520 to authorize an expenditure of $500 to make this improvement. We went to work excavating in the cellar for the pipes and could n't find them. We had to look up the oldest inhabitant, one of the loafers who hang around the court-house, and he told us, finally, where it was located. We found that where it went under the foundation wall there was no arch over it, and the settling of the building had broken the pipe, and the whole system of pipes in the basement was full. I sent for the city hose and turned on the water. The water began to accumulate and rise up. I said, "Let her go." After about half an hour the dam broke and away she went, and our sewer was clean.

Mr. Parks: I have had some experience in the use of flexible shafting, and I think it would be entirely practicable for the purpose which Professor Davis refers to.

The President: I have seen men repairing sewers in this city, using a piece of heavy wire for that purpose, shoving it into all sorts of places. It was quite successful. A few years ago plumbers were called to put a water-closet in the city hall. They put it in, and connected it with a chimney close by, for ventilation. A few years afterward the soil pipe became stopped, but there was sufficient head so that the closet for some time discharged into the chimney, and the chimney became literally full of solid matter, discharged through the ventilating pipe.

Mr. Elder: We have a system of rods, about a quarter of an inch in diameter, connected together with rings. One is

shoved into the pipe and another connected to it. It is used to shove the obstruction out. It will not go around sharp corners. Sometimes if the obstruction is not found at the excavation, they have to cut a hole in the pipe at another place, in order to shove the obstruction out.

Mr. Sears: I would like to ask Mr. Riggs which he prefers, clay or Milwaukee cement, to pack these joints.

Mr. Riggs: The almost universal practise in this country is to use cement. The difficulty that we found in using cement in wet ground was that the water was liable to rise and to disintegrate the cement and wash it away. The only use that we made of clay was where there was a large amount of water or where the water ran back along the pipes; we had clay hauled there in large quantities, and packed it around the joint after the cement joint was made, to prevent washing. It worked well. We had no difficulty where we used it.

Mr. Sears: May I ask further if the drains to carry the ground water were all put in the same trench?

Mr. Riggs: Yes, in the same trench, an inch or so lower than the sewer. We used mostly 5-inch socket-pipe laid with open joints.

Mr. Wells: I think that Mr. Riggs's presentation of this matter of connection of cellar drains with sanitary sewers is very logical and forcible. He has convinced me thoroughly of the excellence of that plan. I wish to add my congratulations to those of Professor Davis, on having a paper of this kind presented. In the matter of making cement joints in terra-cotta pipe, I have heard considerable discussion on the subject of clay joints, and have never heard of but one person who claimed that he could make an absolutely tight joint. I have an idea that in making these joints if you would take a piece of rather loosely woven muslin and sprinkle upon it quick-setting cement while it is dry, and put that on for a gasket, that good results might be obtained. I never put that into practise. I would like to inquire if any one has adopted that plan.

Mr. Riggs: We used cheese-cloth and quick-setting cement in repairing leaks in the main sewer. I stated that we had a

very large leakage in the lower portion of the sewer. We had about 100,000 gallons per day come in upon two and three-quarters miles. We sent a man inside, and he repaired many joints. We used quick-setting cement and cheese-cloth, packing from the inside of the sewer. It was put on to the cheese-cloth dry, and three or four of those rolls worked into the joint with a knife. We shut off a very large proportion of the ground water.

Mr. Sears: May I ask the maximum grade allowable in laterals?

Mr. Riggs: That is a matter that I don't know as any one has ever discussed.

Ques. Is n't it necessary in your system to have a constant supply of water on hand to flush the system?

Ans. We provided flush-tanks on all the laterals. Our plans provide for 57 flush-tanks in the system, each one requiring 600 or 700 gallons per day. But, as to maximum grades, I will state that I believe where I am compelled to use 6-inch minimum, as we had to there, I would rather not go over two or three feet for the maximum. We did use four feet in a hundred where it was not desirable to make a deep cut.

Mr. Brigden: I wish to state in the line of some of the statements made here in regard to the stoppages, that it will become necessary, as has already been done in most New England States, and also in Europe, to provide for the careful inspection of inside fixtures as well as those outside. We, in Battle Creek, have provided for such a set of rules and inspection, and I am glad to say that we have not had a stoppage outside of the main trap in any sewer connection so far. We do not allow any sewer-pipe to be put inside of the building at all. We require double strength or extra heavy cast-iron pipe. Such a case as that reported by Mr. Sears would be impossible unless there were some straight gouging, which of course is liable to take place anywhere. I would not connect the cellars of a city of our size, at any rate, with the sewers. I think the traps would get dry in a great many cases, and there would be a direct connection from the sewer to the cel-

lar. I should be very guarded at any rate, and require a deep-sealed trap, if I was going to connect the cellars directly with the sewers.

Mr. Sears: What are the objections to laying pipe as small as four inches for the flow of sewage?

Mr. Riggs: We don't; ordinarily the smallest public sewer is eight inches, and the size to the curb line is four or six inches, and from there we allow 4-inch to the house. We require all pipes to be back-vented; it does n't make any difference what the connection is, it should be back-vented.

Mr. Elder: Kalamazoo has strict rules in regard to connections. With 4-inch pipe, we very seldom have trouble from stoppages. We are very strict about traps and ventilators and what shall be put into the sewers. We use the separate system altogether. As far as I know, our system is the pride of our city, and is considered by every one who looks at it as one of the finest systems in the country. We had considerable trouble by having the pipes originally too small. When we started out, it was laid out a good deal after the Memphis system, but since then it has been more in pursuance of the separate system of sewers. The only thing that has caused trouble by stoppages has been the elm roots' getting into the pipes; probably nine tenths of the trouble we have results from that alone. We have made some very flat grades, some of them as flat as two inches in a hundred, because we could n't get anything steeper. We have automatic flush-tanks, and the inspector who goes around regularly sees everything is in order. He is employed by the city in other capacities so that the expense is a small one. He goes around probably once a week and puts in two half days. He gets $1.15 per half day for that. He ought to get a good deal more, for he is a valuable man to the city. We don't have more than five or six stoppages a year, and they result from elm roots, generally. The smallest size that we use for laterals is eight inches, but we have four or five miles of 6-inch, put in originally. It will be replaced in time; but the 6-inch is very seldom stopped except by roots.

THE PRESIDENT: What is the diameter of the sewer laid on a 2-inch grade?

MR. ELDER: Twelve inches. It is an old sewer, and we shall replace it as soon as we can with a larger one and a better grade. We lowered it at the outlet to get a better grade, but the sewer still carries the water. I don't know why they did n't lower the outlet at first, but originally they intended to empty into the creek, and had an injunction served on them, and had to empty into the river.

MR. APPLETON: I think there are very few cities where they have rigid enough rules in relation to connecting cellars with sewers, the licensing of plumbers, and all that sort of thing. I have laid a great deal of 6-inch sewer, and I don't remember a single case where it was unsatisfactory. For a small sewer going only two or three blocks, a 6-inch sewer would not stop up as soon as a 12-inch. It is a good many years since I laid 6-inch sewers, but I have laid them in an entire neighborhood. I dislike very much to put down a sewer less than three tenths to the hundred, but if you examine that, you will find that you get about two feet per second.

A BARREL OF SALT.

J. J. HUBBELL, MANISTEE.

It has long been proverbial that the stories told by surveyors and engineers should be taken with a grain of salt. I trust, however, that the society will not consider a barrel of salt as indicative of the size of the story. I intend to furnish enough salt for the entire session, and think it will suffice, if proper restrictions are placed upon certain of our members. A barrel of salt is the unit of measure adopted by manufacturers of the article. The State of Michigan has a large deposit of salt underlying a considerable portion of its area. In the vicinity of Manistee this deposit consists of a stratum of rock salt, from 25 to 30 feet in thickness, 2,000 feet below the surface. I will not attempt, at the present time, to give the geological theory as to the origin and the deposit of the salt. At some future time I may have a story to tell, which I think accounts for the same in a satisfactory manner.

Salt-blocks are usually built in connection with sawmill plants, on account of making use of the refuse as fuel. For this reason the city of Manistee has, of late years, become a large producer of salt; about one half of all the salt manufactured in the State being made at that point. The erection of a block having been determined, the putting down of one or more wells is the first necessity. The site of a well having been selected, a cellar is first excavated and planked up. The derrick is then erected, 22 feet square at the base, 82 feet high, and about 4 feet square on top; the principal ornaments on the top of the derrick being two or three large grooved pulleys with strong journal bearings. The motive power is steam, piped from the boiler room of the sawmill.

The engine cylinder is usually 12 by 12 inches, which, together with the main shaft, is located in an annex to the derrick, 12 by 54 feet in dimensions. The main shaft is driven by a belt, and carries a crank of the disc pattern, with holes for wrist pin,

A BARREL OF SALT

EXPERIMENTS IN SATURATION OF WATER WITH SALT, CONDUCTED BY H.H. HUBBELL AND W.H. HUTTALL FOR THE BUCKLEY & DOUGLAS LUMBER CO. OF MANISTEE, MICHIGAN.

EXPERIMENTS WITH DISTILLED WATER AND GRAINER SALT.

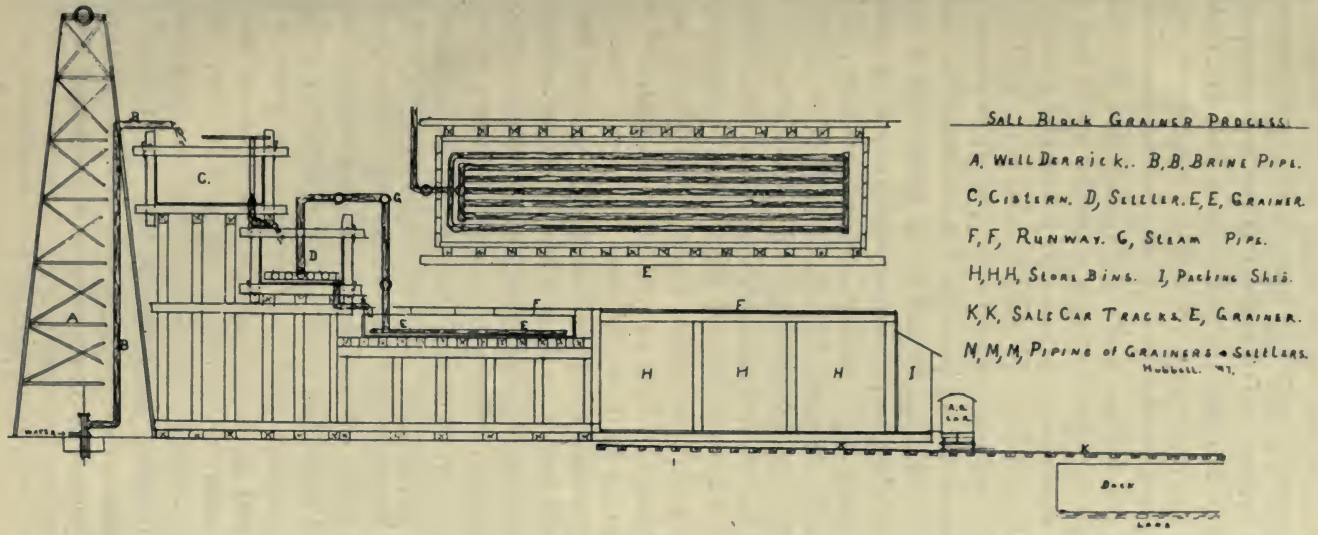
NUMBER OF EXPERIMENT.	OUNCES OF WATER USED.	OUNCES OF SALT USED.	STRENGTH OF BRINE BY SALINOMETER.	SPECIFIC GRAVITY.	PERCENTAGE OF WATER USED.	PERCENTAGE OF SALT USED.	REMARKS.
1	75	20	73%	1.1543	.7395	.2105	EXPERIMENTS
2	75	21	75%	1.1546	.7813	.2187	CONDUCTED IN JARS
3	75	22	77%	1.1577	.7733	.2267	COVERED AND SEALED.
4	75	23	80%	1.1620	.7653	.2347	
5	75	24	82%	1.1647	.7576	.2424	SPECIFIC GRAVITY
6	75	25	84%	1.1678	.7500	.2500	COMPUTED FROM
7	75	26	87%	1.1734	.7426	.2575	WEIGHT OF SOLUTION.
8	75	27	89%	1.1776	.7354	.2646	
9	75	28	92%	1.1848	.7282	.2718	
10	75	29	96%	1.1960	.7212	.2788	
11	75	30	100%	1.2089	.7143	.2857	
12	75	31	100%				

TABLE COMPUTED FROM ABOVE EXPERIMENTS BY H.H.HUBBELL.

STRENGTH OF BRINE.	SPECIFIC GRAVITY.	PERCENTAGE OF WATER.	PERCENTAGE OF SALT.	GALLONS OF BRINE TO MAKE ONE BARREL SALT.	GALLONS OF WATER TO BE EVAPORATED.	BARRELS OF BRINE TO BARREL OF SALT.	REMARKS. SPECIFIC GRAVITY
70%	1.1534	.8027	.1973	174.45	140.11	4.82	DETERMINED BY
71%	1.1536	.7981	.2019	169.30	135.86	4.61	LABORATORY TESTS BY
72%	1.1539	.7933	.2063	161.11	129.17	4.41	ARTIFICIAL GRAVITY BOTTLE
73%	1.1543	.7885	.2115	153.99	126.05	4.19	80%.....1.162
74%	1.1546	.7834	.2166	153.49	123.05	4.17	90%.....1.181
75%	1.1555	.7813	.2187	153.99	120.07	4.15	100%.....1.208
76%	1.1565	.7773	.2227	150.52	117.36	4.08	
77%	1.1577	.7723	.2267	148.05	114.63	4.00	
78%	1.1587	.7716	.2284	146.45	112.81	3.94	
79%	1.1598	.7681	.2330	134.85	110.99	3.90	
80%	1.1620	.7653	.2377	133.23	109.16	3.85	
81%	1.1632	.7615	.2385	131.15	107.10	3.78	
82%	1.1647	.7576	.2424	129.84	105.89	3.72	
83%	1.1662	.7538	.2462	127.18	103.98	0.66	
84%	1.1678	.7500	.2500	125.13	100.85	3.58	
85%	1.1696	.7459	.2541	123.52	99.52	3.54	
86%	1.1714	.7450	.2586	123.53	98.82	3.51	
87%	1.1734	.7380	.2620	121.23	96.91	3.47	
88%	1.1754	.7390	.2610	119.55	95.64	3.42	
89%	1.1776	.7354	.2646	117.86	93.91	3.37	
90%	1.1799	.7330	.2670	116.69	92.39	3.33	
91%	1.1820	.7296	.2704	115.53	91.17	3.29	
92%	1.1848	.7282	.2718	114.36	90.25	3.26	
93%	1.1874	.7265	.2735	113.47	89.38	3.23	
94%	1.1902	.7247	.2753	112.58	88.56	3.20	
95%	1.1930	.7230	.2770	111.69	87.75	3.17	
96%	1.1962	.7213	.2788	110.79	86.94	3.14	
97%	1.1992	.7195	.2805	109.94	86.22	3.12	
98%	1.2030	.7180	.2820	109.18	85.76	3.10	
100%	1.2089	.7143	.2857	107.31	85.03	3.08	

Hubbell '97

giving different strokes from 28 to 40 inches. It is also provided with a grooved pulley by which the main windlass is run by a rope belt. The walking-beam, located partly within the annex and reaching to the center of the derrick, is of hardwood 16 by 28 inches at the center, tapering to 16 inches square at each end, and from 28 to 32 feet in length. The large windlass is placed in a shed lean-to upon the opposite side of the derrick. The other two sides of the derrick are also provided with shed additions. In one is located the blacksmith's forge for sharpening and dressing tools and in the other a large heating stove for the comfort of the workmen, near which the weary driller is wont to sit down to rest and refresh himself. The derrick is also provided with a large wooden hammer, made from a hardwood log 16 feet in length and squared up approximately 16 inches square, which works in movable leaders that open at the bottom like the letter A. A string of tools are made of iron from 2 to 3 inches in diameter and from 40 to 50 feet in length, consisting of the upper stem connected with the lower stem by a pair of jars. The lower stem has a socket for the reception of drills, rimmers, gouges, and other tools, and when complete, weighs from 1,200 to 1,500 pounds. A cable consists of a hard-twisted manila rope from 2 to 2½ inches in diameter and 2,200 feet long. It will weigh about 3,000 pounds. The derrick is provided with water by a small pipe, connected with the nearest water main, also a sand-pump for removing the sand and mud from the well. All being ready, the well is put down by first erecting a section of 10-inch pipe (inside diameter), which is carefully plumbed, and then driven, the sand, clay, or gravel from inside of pipe being removed by sand-pump. It is customary to feel of the ground a short distance in advance of the pipe with the drill, for the purpose of finding any boulders that may be encountered. The 10-inch pipe is usually put down from 350 to 400 feet. When the friction on the pipe becomes too great, the well is continued by inserting an 8-inch pipe inside of the 10-inch, which reaches to the surface and is driven the remaining distance, until the rock formation is found, after



SALT BLOCK GRAINER PROCESS.

A, WELL DERRICK.. B,B, BRINE PIPE.

C, CISTERN. D, SETTLER. E, E, GRAINER.

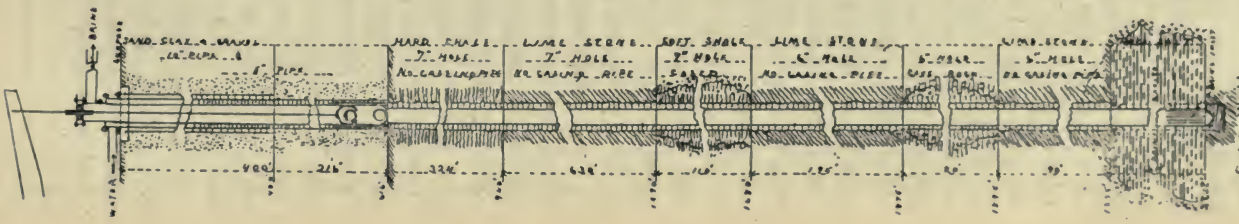
F, F, RUNWAY. G, STEAM PIPE.

H,H,H, STORE BINS. I, PACKING SHED.

K,K, SALT CAR TRACKS. E, GRAINER.

N, M, M, PIPING OF GRAINERS & SETTLERS.

Hubbell. '97.



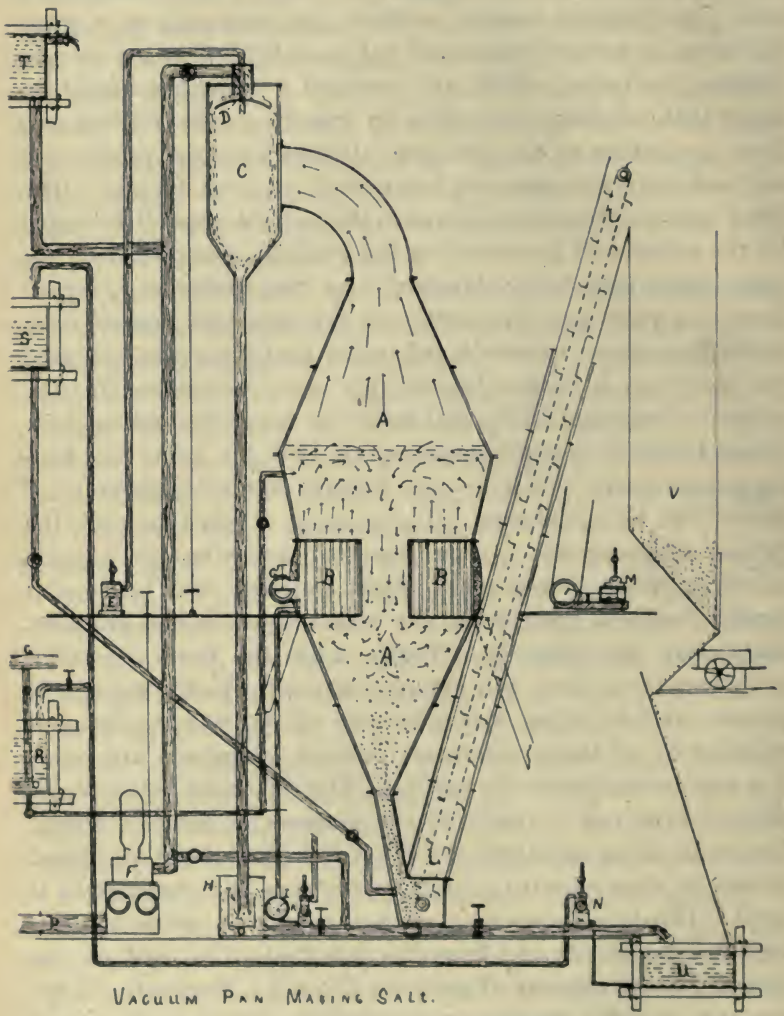
SALT WELL.
2015 FT. DEEP.

which the well is drilled without pipe casing, except such portions as are inclined to cave. I have sketched here a typical salt-well representing the 10-inch pipe as reaching a depth of 400 feet, and the 8-inch pipe to a depth of 616 feet to the rock formation. These figures being taken from the record kept in the putting down of the Buckley & Douglas Lumber Co.'s Well No. 5. We then encountered 324 feet of hard shale, a 7-inch hole being drilled; then 630 feet of hard limestone, which reached to a depth of 1,500 feet. We then encountered a soft shale which was also impregnated with salt or some other soluble mineral, and it has been found very troublesome to pass without casing. It is customary to continue the 7-inch hole through this formation, and then case the cave rock by dropping in a liner of sufficient length to protect this portion of the well. It is in this stratum of rock that we frequently obtain a considerable flow of oil. Below the cave rock we have another stratum of 995 feet of limestone, then another thin stratum of shale, mixed with salt and gypsum, which is also disposed to cave; but being only 20 feet in thickness and the well being nearly completed, it is usually passed without casing. We then have another stratum of 90 feet, of very hard limestone. At the depth of 1,985 feet we reach the bed of rock salt, which is approximately 30 feet in thickness, making the total depth of the well 2,015 feet. The well completed, it is piped for pumping, the lower 1,400 feet consisting of 3-inch pipe closed at the bottom, but perforated with holes or slits for the intake of brine. At the top of the 3-inch pipe is located a cylinder or working-barrel of the pump, the same being of bronze metal $4\frac{1}{4}$ inches in diameter, in which is located the ordinary ball check-valve and piston. The same engine, shaft, and walking-beam used in putting down the well is now utilized for pumping, with a stroke of 28 inches and at the rate of 25 strokes per minute. It will pump from 2,000 to 2,400 barrels of brine in twenty-four hours. In most wells there is not sufficient natural supply of fresh water and it must be supplied from the surface, being delivered between the pumping and the casing pipe. In the first pumping of the

well the brine is usually quite weak, the fresh water admitted not having been in contact with the salt a sufficient length of time to become fully saturated. In time, the wells improve, and as the brine cavity enlarges, give brine having a saturation of from 95 to 100 per cent. It is often a year before the brine in a well comes to its full strength. The brine is pumped to a height of from 40 to 50 feet above the surface to the brine cisterns. One well will produce sufficient brine to make from 500 to 700 barrels of salt daily.

At this point I wish to call attention to some experiments recently made for the purpose of determining the quantity of brine required to make a barrel of salt. The experiments were made with distilled water and vacuum salt, mixing a known quantity of water and salt and noting the strength of brine produced. Ten experiments were made, using in each instance 75 oz. of water and from 20 to 30 oz. of salt, before a solution was produced, which the salinometer showed to be of 100 degrees strength. The specific gravity was also found by weight of solution. From the experiments it was found that 75 oz. of water would absorb 30 oz. of salt. The specific gravity was a little over 120, the percentage of salt 28½, the percentage of water 71½. The number of gallons of brine required to make a barrel of salt is 97 , and the number of gallons of water to be evaporated, 84. From the above experiments I have compiled a table showing the specific gravity, the percentage of water, the percentage of salt, the quantity of brine required to make a barrel of salt, and the quantity of water to be evaporated to make a barrel of salt, for each degree of strength of brine from 70 to 100 per cent. saturation. The experiments are being continued in the line of evaporation by which we hope to determine in a practical way the amount of steam required to evaporate the water from sufficient brine of the different degrees of saturation to make a barrel of salt, which will also furnish us the basis of computing the number of British thermal units of heat required to produce a barrel of salt. This will have an important bearing on the question of fuel and the manufacture of salt, when the refuse from sawmills is no longer available for that purpose.

To return to the manufacture of salt: I have sketched a rude plan showing cisterns, settlers, grainers, and store bins. The brine as pumped from the well is delivered to the storage cisterns, or tanks, which are elevated a sufficient height, in order that the brine may flow by gravity to the settlers and from the settlers to the grainers. Cisterns are not piped, and are used simply to store the brine until required for use. The brine is drawn from the cisterns to the settlers where it is heated for the purpose of precipitating the gypsum, a branch from the main steam-pipe being brought over the settler and turned down to a point near the bottom of the same to a header, from which from seven to nine 4-inch pipes lead the entire length of the settler to a header from which two pipes return for the purpose of running off the tail-water, or water of condensation. It was formerly thought necessary to heat the brine to a boiling temperature, but it is now known that a temperature of about 170° F. is sufficient. Upon being allowed to cool, the gypsum is precipitated. The object of removing the gypsum is not so much to remove a slight impurity, but because it rapidly forms a coating on the steam-pipes in the grainers, obstructing the radiation of heat. After the brine is settled, it is drawn to a long box running across the head end of the grainer, and by holes in the bottom of the box the brine is supplied to all the grainers as required. Grainers are piped in a manner similar to the settlers. The tail-water is frequently used to heat one or more of the grainers in place of steam. The brine being admitted to the grainer, the steam is turned on and it soon acquires a high temperature and evaporation is rapid. The brine, however, does not boil on account of its high specific gravity and from the fact that oil is used on the surface for the purpose of graining the salt. Formerly, butter was used for this purpose, and provided a good market for a poor article. At the present time cottonseed-oil has largely taken its place. The quantity of oil used is quite small, the film upon the surface being as thin as tissue-paper. It is sufficient to cause the grains of salt to form on the surface of the brine, and if left undisturbed, the crystals will be quite large and the salt coarse. For the purpose of precipitating the grains of



VACUUM PAN MAKING SALT.

A, A, Vacuum Pan.
B, B, Steam Bell.
C, Condenser.
D Spray Plate.
E, Air Pump.
F, Cold Water Pump.
G, Steam Pipe.
G', Steam Valve.
H, Sealing Tank.
I, Hot Water Receiver.
K, Hot Water Pump.
L, L, Elevator.
M, Engine.
N, Brine Pump.
O, Water Outlet.
R, Brine Settler.
S, Brine Tank.
T, Water Tank.
U, Brine Vat.
V, Drainage Bin.

Hubbell '97

salt, the surface of the brine is agitated at frequent intervals. This was formerly done by a man with a paddle. He walked the runway over the center of the grainer and stirred the brine alternately first one side and then the other. The same result is now obtained by a series of paddles connected and operated by a lever at the end of the grainer. The salt thus precipitated accumulates at the bottom of the grainer, and in the course of twenty-four hours becomes six or eight inches deep. Each day the salt is lifted by drawing it forward from between the pipes and with a long-handled perforated shovel, lifting it out of the brine and depositing it on the runway. When it is drained, it is shoveled into carts, holding five or six barrels each, and run out over the storage bin and dumped.

I have not given the size and dimensions of cisterns, settlers, etc., as they vary in different blocks. The Buckley & Douglas Lumber Co. has five wells, three cisterns, each 18 by 100 feet and 8 feet deep, which will hold nearly 10,000 barrels of brine, and six settlers, 12 feet wide, 175 feet long, and 8 feet deep, which will hold nearly 24,000 barrels. When these cisterns and settlers are all full, they have enough brine in store to manufacture over 10,000 barrels of salt. Some blocks are run without cisterns, pumping the brine directly to the settlers. This arrangement requires more settlers, and as they are expensive on account of the piping, it is better to store part of the brine in cisterns. They have twelve grainers, which are 12 feet wide, 150 feet long, and 20 inches deep, which ordinarily will make 100 barrels each every twenty-four hours, or 1,200 barrels a day.

This company also manufactures salt by the vacuum-pan process, and for that purpose has two pans. I have also drawn a sketch of a vacuum-pan. In exhibiting this drawing I am reminded of a showman, who, in exhibiting a painting of "Daniel in the Lions' Den," remarked "that Daniel could be easily distinguished from the other animals by the green cotton umbrella under his right arm." So I hope you will be able to distinguish the various parts of this drawing when I tell you what they are. The main central figure represents the pan

itself, having a diameter of 11 feet at the steam belt and a height approximately of 50 feet. The steam belt, which divides the lower and the upper parts of the pan, consists of two copper heads connected by 1,100 copper tubes about 5 feet long and $2\frac{3}{8}$ inches in diameter. There is also a large central tube, about 3 feet in diameter. Below the steam belt the pan tapers rapidly to a pipe about 12 inches in diameter, which extends to the foot of the elevator, which carries the salt up in a manner similar to that in which wheat is elevated in a mill. Above the steam belt the pan enlarges rapidly to a diameter of about 15 feet, then contracts to a diameter of 4 feet and with a right-angle turn enters the condensing chamber.

The condensing chamber is supplied with water by the large pumps located on the lower floor. The water is forced upward and enters the top of the condensing chamber, falling upon the spray plate, and having absorbed the steam from the pan, passes down to the water-pipe. The foot of this pipe rests in a sealing tank to prevent the intake of air. The air pumps for creating the vacuum are on the second floor of the block, the suction-pipe running up and entering the condensing chamber near the water inlet and reaching to a point just beneath the spray plate. The pans are usually filled with brine from a small tank located at a sufficient elevation so that the brine will flow to the pan by gravity. After being filled, this source of supply is closed and the valve in the pipe connecting with the settlers opened, and the brine is drawn into the pans by the vacuum, as the evaporation proceeds. The water and air pumps started, steam is admitted to the steam belt, and the process of manufacturing salt begins. The pressure of the air being removed from the surface of the brine, it boils furiously at a low temperature of heat, the heat of brine in the pan seldom being more than 150° F. The brine rushes upward through the tubes. Evaporation is rapid, the steam passing to the condensing chamber and the brine becoming so dense that it will no longer hold the salt in solution. Fine crystal grains are formed when passing down through the large central opening of the steam belt, and settling to the bottom of the pan,

pass off through the lower pipe to the foot of the elevators, whence it is elevated and dumped into drainage bins, the vacuum holding the liquid brine up in the pan where it again passes upward through the tubes; and so the operation of evaporation and formation of salt continues. The steam entering the steam belt from main pipe having a pressure of about 20 pounds to the square inch, parts with its heat so readily and rapidly under these conditions, that there is usually no pressure in the steam belt. The water condensed from the steam belt flows through pipes into a reservoir, and is pumped back to the boiler house, still retaining a considerable heat, where it is purified and treated with oil separators before being returned to the boilers. The salt in the drainage bin, after draining from sixteen to eighteen hours, is drawn off into carts, wheeled to the storage bins, and dumped. The brine draining from the salt is caught in a vat from which it is pumped back to the settlers or to the small tank used for filling the pans when starting. Pans are usually used only twelve hours. They are emptied, boiled out with fresh water, and cleaned. In this way the two pans are run, one during the day and the other during the night, each pan making in a twelve-hour run from 600 to 700 barrels of salt, producing together from 1,200 to 1,400 barrels a day.

The generation of steam for a salt-block is an important feature of the business. It is customary to put in additional boilers in addition to the sawmill boilers, having a capacity of at least twice the amount of steam required for running the sawmill alone. The fuel consists of sawdust and other refuse, which is ground with machines known as hogs, so that the entire fuel can be elevated, carried with conveyors, and fed to the furnaces without being handled by hand. The steam, or a sufficient amount of it to produce all the power needed, is used in the engine cylinder with a back pressure of approximately 20 pounds. All the engines about the plant have their exhaust confined to large pipes under this pressure, using steam with a boiler pressure of 100 pounds, and exhausting into pipes with 20 pounds back-pressure. This practically obtains the expan-

sive force equal to 80 pounds pressure and loses but very little of the heat. This exhaust-steam is carried to the salt-block and used either in vacuum-pans or grainers. Additional pipes carry live steam direct from the boilers having both high- and low-pressure, the low-pressure being produced by passing the steam through reducing valves, and the high-pressure steam being used for running both water and air pumps in vacuum-pan block; also the pumping engines at each well.

The plant to which I refer has seventeen tubular boilers 5 feet in diameter and 18 feet in length. The pipe carrying the exhaust steam to the salt-block, being 16 inches in diameter, is well protected with asbestos covering. There are also two 10-inch pipes well covered.

The whole question of fuel supply, combustion, the generation of steam, and devices to prevent loss of heat by radiation, is an important feature in the manufacture of salt; but it was not my intention to enter into the details of this branch of the business.

After the salt has been manufactured, it is usually allowed to remain in the storage bins from sixty to ninety days to dry out. The State salt inspector determines when it is fit for packing and shipment.

The manufacture of barrels in itself is a large industry. The staves and heading are made from the slabs and other refuse of the mill. The hoops are usually manufactured elsewhere and purchased. The Buckley & Douglas cooper shop is run by an electric motor, and is provided with all the modern machines, consisting of power windlasses for the setting up of barrels, heaters, truss machines that set the truss-hoop on both ends of the barrel at once, crozing machines that trims and cuts the crozing on both ends of the barrel at the same time, which, with expert workmen for putting on hoops and heads, make lively work in the production of barrels, the capacity of the shop being about 200 barrels per hour or from 2,000 to 2,500 per day. The barrels are counted as they leave the cooper shop, by a machine similar to those used for counting the strokes of pumps or steam-engines at water-works and other places.

The packing of the salt is done by gangs of three men, provided with shovels, pickaxes, mauls or pounders, hatchets, etc. They work on the floor of the storage bins, two men filling the barrels while the third man does the heading up. After being barreled, the salt is loaded directly into cars stationed at side of block, or is loaded on platform salt cars, holding fifty barrels each, running through the block. The platforms are on the same level as the floor, and cars are drawn by horses to the ware house on the dock, where they are stored ready for loading on vessels. Considerable salt is also shipped in bulk, usually being handled in carts holding six barrels each, which are run directly over the hatchway of the vessel and dumped. Steam or grainer salt requires a much larger barrel to hold 280 pounds, than vacuum-pan salt, and where both kinds of salt are manufactured, two sizes of barrels must be provided.

I have here a number of blue prints showing some of the details of a block, also samples of both the grainer and vacuum-pan salt, which, no doubt, some of the members would like to sample.

Mr. Wells: What does the vacuum-gauge show when you are operating the vacuum-pans?

Mr. Hubbell: What we would refer to as 25 inches lift. That will boil rapidly at 120 or 122, but we succeed in getting heat on to it of about 150. The brine in that vacuum-pan just foams, thrown up four feet, the steam is so anxious to get away.

Mr. Wells: Have you ever made experiments to determine the amount of heat necessary to evaporate brine in the grainer and in the vacuum-pan?

Mr. Hubbell: We never had the apparatus to try it in the vacuum-pan. We have commenced experiments in the open air with a miniature grainer for the purpose of determining that, but the only comparison we can make is the heat supplied. Our 16-inch steam-pipe supplies both the grainer and the vacuum-pan, and we have no way to determine.

Mr. Williams: What does it cost you to make your barrels?

MR. HUBBELL: Approximately 15 cents.

MR. WILLIAMS: Do you know what proportion of that is labor?

MR. HUBBELL: No; I could n't answer that question. I might say that our experiments in fuel figure about 7½ cents for fuel to make a barrel of salt. You can put that with the 15 cents for the barrel, and allow 10 cents for labor, probably less than 10. When we were selling salt for 35 cents, we were n't making any money, but when it was 65 we were very well satisfied. Dry wood is valuable for fuel about in proportion to its weight, a pound of pine being about equal to a pound of hardwood.

PROFESSOR DAVIS: That is the rough estimate, that the weight estimated very well the relative value of wood fuel. It is not scientifically correct, but it is a good rule to go by.

MR. HUBBELL: Mr. Hodgman has asked me how much territory we were undermining. I have not been down to see. We find that in a well, used a year, if a new well is not put down over 100 feet from the old one, it will strike into the brine basin of the old well. So it will enlarge 100 feet in diameter the first year. Of course as time goes on it will increase slower.

MR. APPLETON: The salt stone is about 30 feet thick; does the brine basin extend clear to the bottom of that layer?

MR. HUBBELL: The salt seems to be a uniform stratum 25 to 30 feet deep, and underneath is limestone, I think. I am not sure, but that is my understanding. We never drill but a little way, hardly enough to tell what it is.

MR. WELLS: Do you get any lime in the salt?

MR. HUBBELL: Not except in the shape of gypsum. The finished product may show a trifle, though I don't think it shows any; but gypsum is the form.

MR. APPLETON: Suppose that the undermined earth should settle for 30 feet. You don't leave any columns for support, and if it should settle 30 feet, you will feel it on the surface.

MR. HUBBELL: You must remember that the pressure of the water in that brine cistern is between 800 and 900 pounds to the square inch at that depth.

CURB AND SIDEWALK GRADES.

W. D. ELDER, KALAMAZOO.

A seemingly trite subject is this, yet I hope I may offer a few suggestions which will be useful. In many cities, undoubtedly, sidewalk grades have become a definitely settled subject. In others, especially some of the smaller cities, I am persuaded it is a floating subject. I speak, of course, largely from the experience obtained and the conditions found in the town with which I am acquainted, and presume that similar conditions prevail elsewhere. One does not have to go very far to find places where sidewalks rise and fall like the waves of the sea, and where curbs are often far above and sometimes far below, and where new grades are established which "hew to the line, letting the chips fall where they will." Fine lawns are buried, handsome shade-trees are ruthlessly uprooted, and houses are left high and dry, looking down upon the street like a lighthouse off a bleak headland. Meanwhile, the property owner is in despair for fear that a change in administration next year will result in a change of grade.

In Kalamazoo, the owner is responsible for the sidewalk in front of his property. The city must see that the walks are kept in proper repair, and if they are found defective, must notify the owner. If he refuses or fails to make the necessary repairs, the city does so, and the expense is assessed on the property. If injury results to any person from a defective sidewalk, the city is held liable. So perishable are the old plank walks in use that one or two inspectors are kept watching them all the time, and yet the city is constantly having damage suits on its hands.

In September, 1891, the city council passed an ordinance granting a rebate of three cts. per square foot to all property owners who would build cement walks. In June, 1894, this was increased to five cts. per square foot, and a little later, the building of cement, stone, or brick sidewalks was made

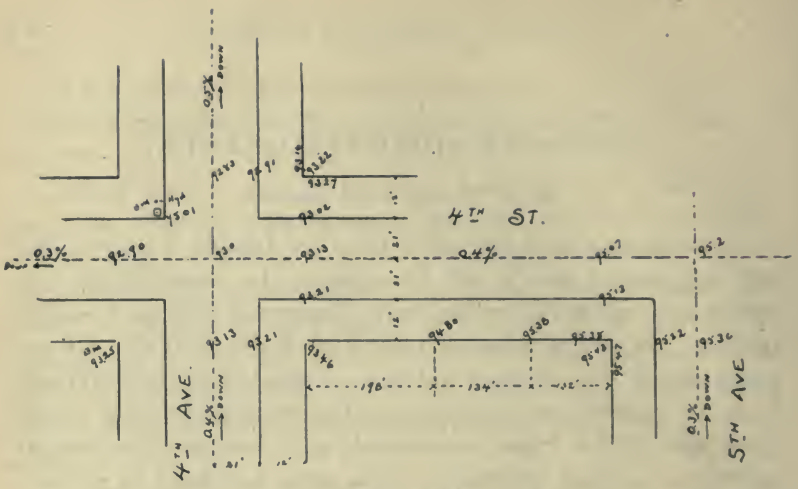
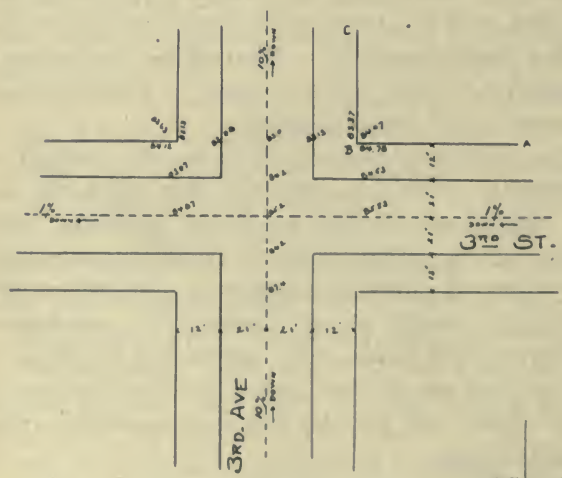


FIGURE 1

Two Intersecting Grades.

Also Showing special Sidewalk Grade.



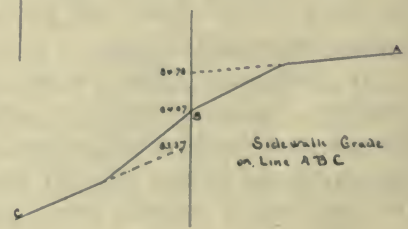


FIGURE 2

Grade on Avenue to Steep
for Continuous Cross Section

compulsory within certain districts. Owing to sharp competition, the price of the builders has now been reduced to 11 cts. per square foot, leaving the net cost to the owner of 6 cts., which is about 40 per cent. more than a plank walk could be built for. The life of a plank walk will not exceed ten years, and is generally much less. The cement walk, if properly built, lasts forever.

Among other specifications, these walks were required to be built to a line and grade set by the city engineer. As the owners did not rebuild their walks except when the plank walks wore out and had to be renewed, it will be seen that the cement walks were built in patches, and it became necessary to fix on a grade which would not have to be changed under any future circumstances, and yet which would not vary any more than was absolutely necessary from present circumstances, which would make very bad-looking breaks and jogs. Finely improved lawns, handsome shade-trees, cement walks already built, had to be preserved. Of course, on some streets pavements and other improvements already fixed the grade, but on others, expensive improvements in the way of buildings and so forth, had been made without reference to any grade.

Now, in fixing the grade for a street, three important points must be held in mind.

1. The street, when brought to a grade, must look well,—symmetrical and no abrupt changes.

2. There must be as little variation as possible from present conditions, both in the street and with reference to adjoining property.

3. The grade must be fixed so as to afford proper drainage.

The grade should, when possible, be a straight line, all breaks coming at the center of street intersections, and as few as possible between streets. This can be generally done in a comparatively level country. If sharp breaks come in a block, vertical curves should be put in. Long, vertical curves and reversed curves should be freely used especially in broken and hilly country, as they make a very graceful-looking street. Grades should, if possible, be carried across intersecting streets

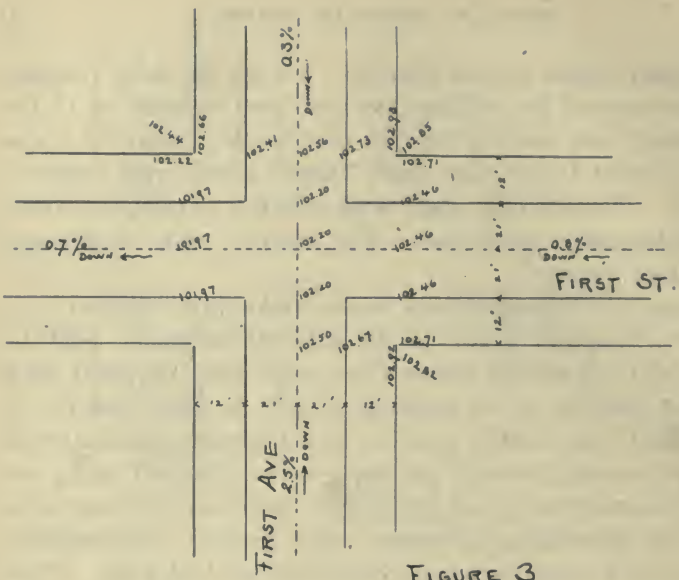


FIGURE 3

Valley on Avenue
Continuos Grade on Street

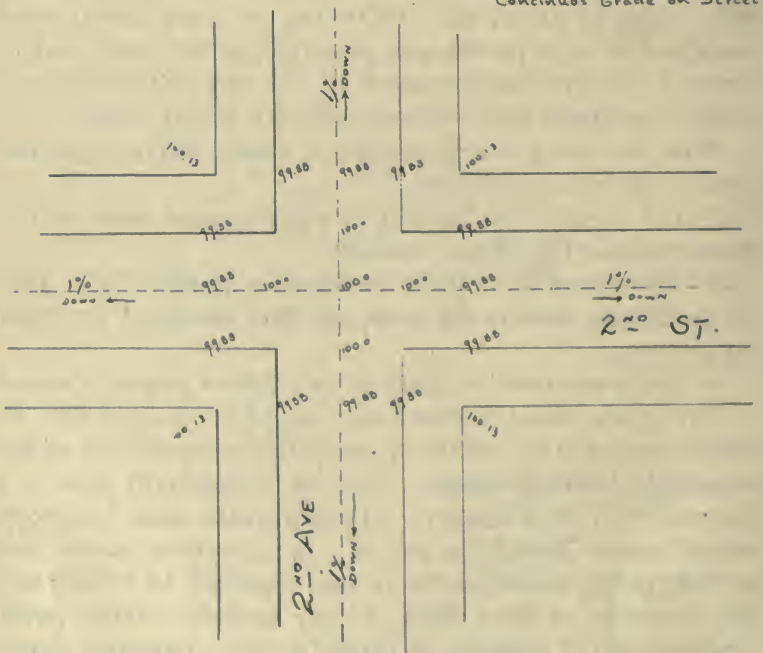


FIGURE 4.

Crownson Both St.

without the double breaks sometimes seen. Of cross sections and intersections, I will speak later. I might say, however, that there is no objection to one side of the street being higher than the other, and on side-hill streets it will look far better to have the street conform as much as may be with the general lay of the land, than to have a level cross section. Lots should be graded as far as possible to conform to this slope, and not made level both ways, with an abrupt precipice at the back end of the lot.

The matter of grades is often entirely neglected in the laying out of town sites. Streets are laid out, east and west, and north and south, and just so far apart without reference to topography or location with reference to the neighboring city. All the streets run up and down, and the general directions of travel is always up one street and down another; and, although vast sums of money are spent in grading the streets, the effect is still, and always will be, anything but pleasing. I am not advocating the curved streets found in the so-called "Park Additions," though some of these are very pleasing for variety; but a little careful figuring to permit the streets to be laid out so as to avoid a great amount of work and even a diagonal street or two. A diagonal street is often a great convenience in approaching a city; and if a ravine can be used for such a street as shown in Fig. 7, not only is much expense for grading saved, but there is given a quick entrance into the city and a long, easy grade from the valley level of the city to the prairie level above the city which may again be laid out in square blocks. Compare this with Fig. 8, showing the same country laid out with square blocks. The additional expense for grading will greatly exceed in most cases the advantage derived from all square lots. These figures are an expansion of an actual case.

As to the third point: a great deal depends on the topography of the site, on the nature of the soil, and on the system and extent of the sewers. In a town well suited for the separate system of sewers, and having a comparatively flat surface, it becomes a very important consideration. So to

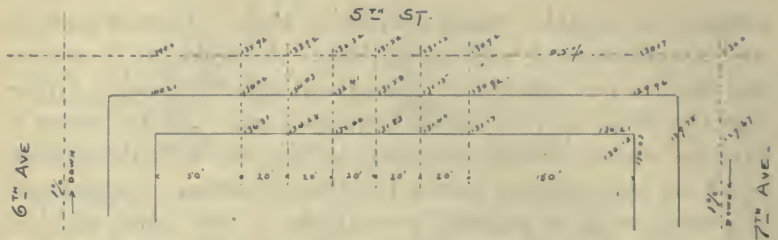


FIGURE 5
A Curved Grade.

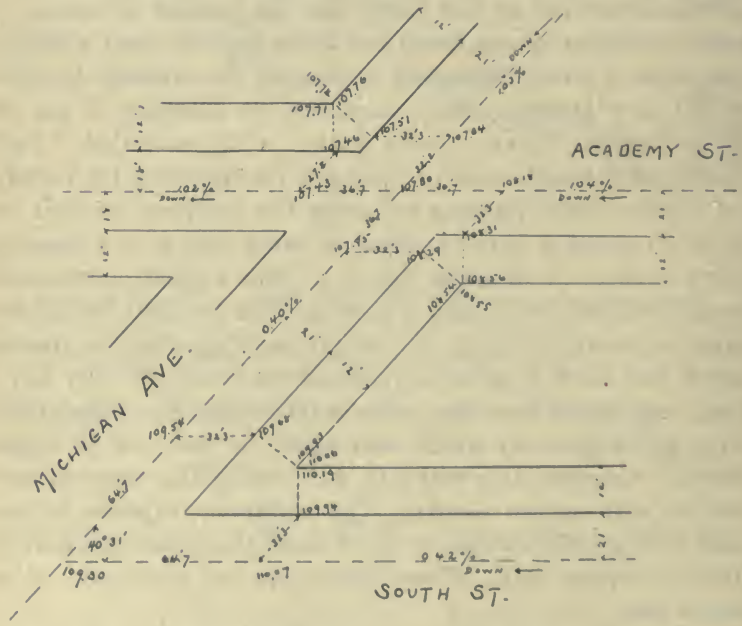


FIGURE 6
Angling Intersections.

devise the grade as to afford a suitable drainage without sewers or with a minimum number of storm sewers, and yet with a minimum amount of change, is the problem which is often quite intricate. It is this problem which we have had constantly repeated, as one new district after another in our city has begun the construction of cement walks.

The procedure is as follows: First, a system of benches, then profiles of all the streets. We do not like fire-hydrants for benches, when anything better can be found. They are easily found, and easily described, but they are also easily moved by the water department without notice; when they already exist; and as fast as they are built, we use the inside corner of cement walks. If the grades are checked, after the walks are built, these elevations are easily obtained. The accuracy and completeness of the profiles vary according to the improvements on the streets. On an ordinary level street, we take center readings every fifty feet and side readings on the walks or lawns every one hundred feet. Sometimes the side readings must be taken much oftener. If large trees are frequent and their bases are at much different elevations from the center of the street, we take separate and careful side profiles, so as to fix the grade which will not injure the trees. On a paved street, where the curb grade has to be changed, or curb surfaced up, we take separate sets of readings on each curb on the inside edge of the walks, every twenty-five feet if necessary, and in the door-steps of various buildings.

For working profiles, we use Plate A, and plat forty feet to the inch horizontal and four feet vertical. If the streets are very steep and the hills long, we sometimes use eight feet vertical, and in business districts and other places where we wish to be quite particular, we use two feet to the inch as vertical scale. If these profiles are to be kept in the engineer's office and he is to be the only one to use them, it is unnecessary to make any other profiles.

If they are to be turned over to untechnical hands or kept for general inspection, permanent profiles should be made in a book or on sheets, afterward bound into a book, for which

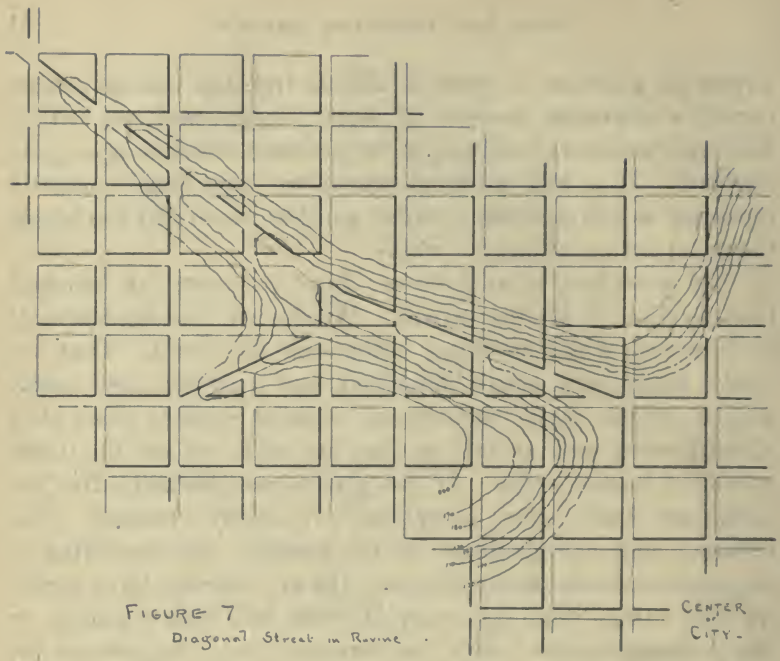


FIGURE 7
Diagonal Streak in Ravine.

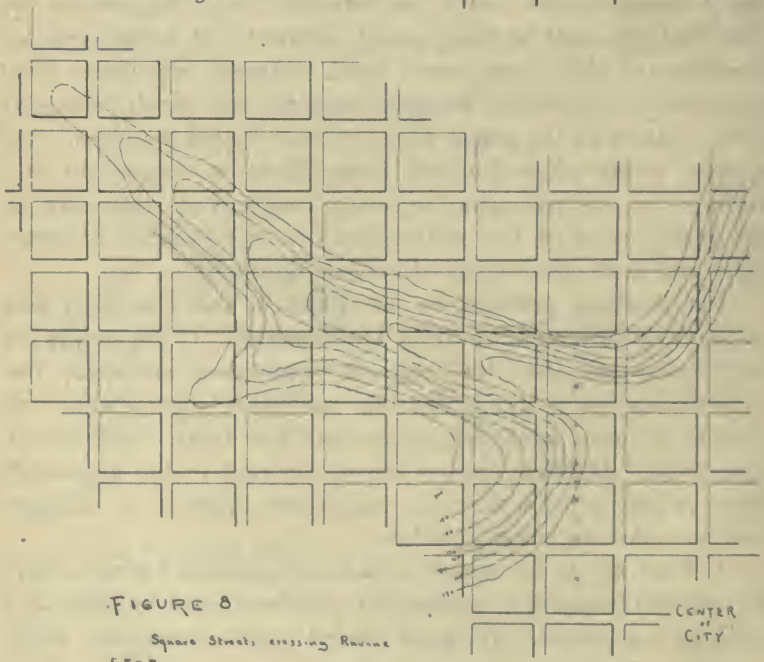


FIGURE 8
Square Streets crossing Ravine

Plate B paper is preferable, being more compact; all the profiles, of course, should be made to the same scale. A more convenient form of record, however, I think, will be in the form of maps showing the elevations in figures, as I shall show a little later. As an additional aid to the working profiles, it will be found convenient to make a map showing the elevations at all intersections and at points between where sudden breaks occur, perhaps in some cases, a contour map will be serviceable. An exhaustless amount of "cutting and trying" will be necessary to fix the most desirable grade. This having been done, it should, as soon as fixed by ordinance or otherwise, be indicated on the profile by a red line, showing the grade for the center line of the street. The curb and sidewalk grades should be figured from the center grade by fixed rules, and the fit of the sidewalk grades as thus figured, will be one of the important considerations in fixing the center grades.

For figuring the curb grades, when the intersection comes in the valley between two descending grades or on a hill between two ascending grades, the curbs should be set level, but in the case of a continuous descending grade, the curbs at an intersection should conform to the grades of the intersecting streets, unless that grade should be so steep as to give a dangerous or inexpedient pitch to the cross-section of a street, in which case the maximum cross pitch allowable should be used, the break being made at the curb lines. With these considerations, the curb is the sole user of the center grade, the center of the street being raised or lowered to whatever extent is necessary to give the desired crown to the pavement or desired depth to the gutter. Often the gutters may be fixed with a varying depth, so that the curb may be level or nearly so for a block or more. The manner of figuring the elevations of curb at intersections and so forth is shown in the accompanying diagrams. The proper elevation of the sidewalk above the curb is a matter concerning which there is a difference of opinion. In Kalamazoo, the rule is one-fourth inch to one foot, starting from the curb whether the space is occupied entirely by walk or partly by a lawn. This should be the minimum. In Kalamazoo, the

walk grade is often fixed for a certain block or distance at a much higher elevation, especially in the residence districts, to preserve trees. Here, when a lawn intervenes, the walk may be raised a foot or even two or three feet, the only limit being caused by the approaches to drives entering the lots. It is generally intended to make these come down at the curb line to the gutter level, bridges across the gutters being avoided if possible. Fine as a street may look with a broad level cross-section, we do not believe it improves it to sacrifice the beautiful trees which have required thirty and forty years to reach their graceful dimensions. In the business districts, the walks are sometimes raised a little above the curbs at the curb line, the maximum being about three inches; a maximum slope of one-half inch to the foot is then allowed, and next to the buildings may be built a ledge three feet wide and two to six inches high. The latter also serves to conform the sloping grade of the walk to the level grade of the building. In figuring the grade for a corner, the rise is figured from the curb each way and the average of the resulting elevations taken for the grade at the corner, the grade reaching the proper difference above the curb at a suitable distance each way from the corner, as shown in the accompanying sketches.

The most rapid and convenient way of setting a grade is by the method of "tipping the level." The proper grade being set at each street corner of a block or any other convenient points, the level is set over one of them, two of the screws being brought into line; the target is set at the reading thus given at this point; the rod is held on the other grade; and the instrument is tilted till the line of sight is on the target. As many intervening stakes as desired may then be set with the same target reading. It is not necessary that the level be on the line of stakes. If the curb and sidewalk grades are parallel, the grades for curbs and sidewalks on both sides of the street for one or more blocks can be set with one "set up" and two rod readings.

A careful and accurate record of all grades set should be kept. We have found it most convenient to keep the diagrams

as shown in the sketches. If a complete map of the city, or a book containing the map in sections of a block or two, be made, and these grades copied there complete, including the benches used, the use of the cumbersome profiles as records may be largely dispensed with. We generally distinguish sidewalk grades which vary from the grades as figured from the curbs by one-fourth inch to one foot by blue or green ink, and elevations of walks already built, by red ink. The curb grades as thus recorded are, of course, the established grade for curbs to be set in the event of any future pavement or other improvement on that street.

PRESIDENT: This is an interesting paper on a proper subject. A large part of my work for the last year has been setting sidewalk grades. I generally use a transit.

MR. ELDER: We use a transit sometimes, but have found the level to be more reliable.

MR. SEARS: I would like to ask in regard to the cement walks that have become very fashionable in many places. My observation shows that with insufficient foundations there is very little economy in their use. I would like to know something about the style and the depth of the foundation, and also the thickness of the upper covering.

MR. ELDER: Our specifications in Kalamazoo are not all that they ought to be; but we find that where built according to specifications they are all right and are very good. We use sand and gravel mostly. Our rules require eight inches of sand well settled. It is excavated one foot deep and the sand well settled. On top of this, the rules originally called for three inches of concrete and one inch top, but we found it better to use more concrete and less top. Our specifications are faulty in one respect. They require that one barrel of Portland cement be used in every fifty square feet of walk, but it does not specify how much in the concrete and how much in the top.

MR. SEARS: Don't you find sand as good as broken stone or gravel?

Mr. Elder: Better for most purposes; we almost always use it.

Mr. Appleton: Sand is a natural drainage and that is the good of it. My friend pleases me very much by his paper, but one thing does n't please me. That is when he says the cement walks will last forever. That is a terrible walk. My friend, tree roots will crack them so that they will go all to pieces, and they will go all to pieces without tree roots. I never saw a piece of that kind of walk that was laid 6 or 8 years but what had cracks in it in all directions and of all sorts. There is no way of building these walks but that after a few years they will crack and go to pieces.

Mr. Elder: In Kalamazoo we can show you miles built for twenty years.

President: We find that where the walks are well laid they are lasting better than flagstones.

Mr. Appleton: Yes, where they are well laid, where there are no tree roots, and where they are well tamped, with good drainage, they are better. One of the best pieces that I know of is the large piece around Capitol Square. That work is standing very well, but it is going the way of all flesh.

Mr. Sears: How does the cement walk compare with the brick walk?

Mr. Elder: We have n't enough of the brick walk to tell, except some recently laid.

Mr. Sears: I have found that good pine boards on cedar sills and subsills, properly separated, make the best walks. I have some twenty years old in service to-day. Most of them place the sills right on the surface of the ground, and the plank in contact with rich ground, and they rot out in five or six years.

Mr. Appleton: We are continually having damage suits from our sidewalks, and the greater the distance from the surface of the ground to the surface of the plank, the greater danger there is to life and limb.

INTERLOCKING SWITCH AND SIGNAL SYSTEMS FOR THE PROTECTION OF RAILROAD CROSSINGS, JUNCTIONS, AND DRAWBRIDGES.

ALEX. MOORE.

The application of this class of machinery in the construction and operation of railroads to assure safety at points on lines where the route may be obstructed or impassable, has become quite general during the last few years.

The laws requiring all trains to be brought to a full stop before passing over a grade crossing, apparently meets all the requirements for safety, but experience has taught that the provisions of the statutes are not always observed, and notwithstanding the stringent rules published and in force on all railroads requiring observance of this law, trains do not stop and collisions occur.

The danger of collision and frequent loss of life and property, the time lost and the expense involved in making stops, make the grade crossing a constant source of annoyance in railroad operation.

To avoid this danger and expense, interlocking and derailing switch and signal systems have been devised for the protection of trains at grade crossings. These systems consist of derails, switches, and signals properly placed with reference to fouling point at crossings, which are manipulated by levers grouped in a tower at a central point, and so arranged, connected, and interlocked as to make it impossible for the signalman in charge to give conflicting routes or signals, or to organize an accident by permitting two trains to collide at a crossing or junction.

The locking, briefly described, is actuated by the movement of the latch rod or by a device performing similar service in advance of the first movement of the lever. The levers are so arranged that when all signals are in normal position, that is, at danger, the levers operating derails or switches are free to move, provided that the preliminary act of revers-

ing any lever shall lock all signal levers controlling opposing routes, and the arrangement of the locking shall be such as to make it impossible to give clear signals for any route until all points are properly set. Aside from the interlocking in the machine proper, bolt or wire locks are provided at all facing points to insure positive closure before signals can be given.

With this brief description of the general construction of standard interlockings, with which I presume most of the members are familiar, I desire to call the attention of this association to some of the features involved in this class of protection, which are open to criticism, and upon which differences of opinion exist among expert signal engineers, or others particularly interested in the safety conditions demanded.

First, the use of the derail as a physical and moral safeguard. The discussion of this subject in which several times the writer has participated, has developed arguments against the use of the derail as follows: danger to passengers and employees in case of derailment, especially where course of derailed train is purposely diverted positively to avoid fouling the opposing track; seriously delaying traffic at congested points in case of derailment; positive impediment to traffic in transfer of business at important crossings or junctions; and that serious derailments often occur through the negligence or misapprehension of the signal operator, which, without the use of the derail, could be avoided. It is also contended that the modern methods of education and discipline of engineers in charge of trains render the derail unnecessary, as is shown by the infrequency of crossing collisions.

The points in favor of the installation of the derail are: that it furnishes physical protection, as well as acts as a moral agent in requiring implicit observance of signals; for it is a common knowledge that the signal cannot be cleared until the derail is closed and locked tight against the traffic rail. Knowing this, it follows that the engineer or motor-man will not regard his own safety, that of those under his charge, or his reputation so lightly as to pass a signal at danger, even though his train be under control.

Therefore it is held that aside from the physical protection afforded by the derailment of trains not stopping as required by law and rules, the derail certainly prompts or nearly insures positive compliance from a moral standpoint, in that the knowledge of the personal danger and the application of penalties for non-compliance with rules and law makes the fulfilment of this duty morally certain.

There is no means of securing accurate data as to even an approximate amount of casualty or damage caused by the derailment of trains by non-observance of interlocking rules, though we know of several serious accidents from this cause which involved loss of life and excessive damage. It is the consensus of opinion that the use of the derail in connection with interlocking systems has been a competent safeguard against crossing collisions.

If the derail is an evil, it is, in my opinion, the least of two evils, therefore, possibly, a necessary evil, and should not be debarred from use under reasonable conditions, in connection with signals at railroad grade crossings and drawbridges.

This matter has been considered of sufficient importance by railroad engineers and managers that it has been made the subject of legislation in several States, notably, Michigan, Ohio, and Illinois.

In the States named, railroad commissions must pass upon and approve plans for all interlocking systems, as well as approve the plants after completion, directing the rules of operation, speed of trains over interlocked limits, etc. In Illinois, all tracks in the limits of interlocking must be provided with derails by a fixed rule of the commission. In Michigan, the Commissioner of Railroads specifies to what extent the derail shall be used in tracks adjacent to crossings or junctions, insisting, however, that all main or high-speed routes crossing each other shall be provided with derails.

On crossings of secondary tracks or spurs by high-speed lines, it has been considered sufficient to install derails in the secondary tracks only, with high-speed route full signaled, all properly interlocked and operated by train or switchmen on spur route.

While the propriety of this custom may be considered doubtful from a standpoint of absolute protection, the commissioner has approved this form of appliances mainly because full interlocking and derailing systems with the necessary expense of attendance, would render the operation of such secondary tracks or spurs prohibitive.

Regarding the efficiency of the derail, very much depends upon the point at which it is placed. It has been the custom in this State to restrict the speed of trains not to exceed twenty miles per hour while passing the limits of interlockings, but these instructions are not obeyed, and habitually engineers in charge of trains acquire overconfidence in the safety of the appliances, and it is a fact that many of our most important fast trains run over interlocked crossings without decreasing speed.

Realizing that the popular demand for rapid transit, as well as the competition between rival lines, makes it nearly impossible to secure compliance with instructions regarding reduction of speed at these points, it is necessary to turn our attention to perfecting the appliances used and making all the mechanical conditions equal to the necessities. While the speed of trains has very materially increased from the causes before mentioned, the position of derails with reference to the crossing, remains about the same, as a rule, 300 feet; whereas, they should, in my opinion, be at least 500 feet from the fouling point. I should hesitate to recommend that rails be placed in position to divert derailed engines or trains to the ditch or possibly against obstructions, as is advocated by some engineers and managers, but would prefer that the obstructive limits be extended by placing the derail farther from the crossing.

From practical observation and experience I beg to submit that the derail should be generally applied in the installation of interlocking machinery. There can, however, be no fixed distance or method of locating it; the place and the manner should be determined by conditions of the tracks and the character of the traffic.

There may also be conditions where the installation of a derail might prove not to be a factor of safety, in which case it should certainly be omitted.

Proceeding to the consideration of some problems in signaling, in connection with interlocked crossings: the signals in general use are of the ordinary semaphore type, the home signals being placed about 50 feet in advance of the derailing point with red blade in horizontal position, indicating Danger — Stop! and when depressed at angle of about 60 degrees, indicating Safety — Proceed. At night, lights are shown through magnifying and spectacle lenses, red for danger and white for safety.

The distant signals are ordinarily placed from 1,200 to 1,500 feet in advance of home signals, with green blade, horizontal position, indicating Caution, and depressed indicating Safety.

Green lights are used at night for caution, and white for safety.

The distant signal is permissive, trains are necessarily allowed to proceed beyond it under control, and it is found that one menace in the operation of interlockings comes from the fact that enginemen place too much reliance on the distant signal when placed clear or in safety position. The most serious derailments at interlocked crossings that have occurred in our State have been caused by signalmen in tower changing signals and opening derails after trains had passed distant signals at a high rate of speed.

It was thought no signal operator would be so unmindful of his responsibility as to do this, but experience has taught us differently. Since human agency cannot be relied upon, and high speed at interlocked crossings is the rule rather than the exception, the aid of electricity has been invoked, and by a very simple device, using the ordinary rail circuit and electric lock, trains can automatically control the route when set clear for it.

This is accomplished by electrically locking the lever, controlling the derail when the train is at any required distance

from the crossing. After the first pair of wheels in a train have entered the limits of the rail circuit and until the last pair of wheels have passed over and beyond the crossing, the signalman is powerless to change any levers in the machine, except, possibly, the signal levers on the route used. It is advisable to attach the electric lock to the derail lever instead of signal levers, so that signals may be utilized should train stop in interlocked limits.

It is advised to extend the rail circuit governing the electrical locking about 300 feet in advance of the distant signal.

I am of the opinion that on all high-speed routes, unless electrically locked as described above, the distant signal should be treated simply as a marker, and should not be connected and operated, but fixed in a position indicating caution.

I am aware that this is a radical departure from what has been considered standard usage in operation of interlocking plants, but taking into account the tendency to high speed over crossings thus protected and the liability of towermen to error, I contend that it will divide the responsibility, and must result in slower and more careful speeds, unless the proper appliances for perfect safety are applied. I have recommended to the Commissioner of Railroads of this State that this stipulation be made ; and though it has not been generally adopted, a large number of orders have been issued, discontinuing connections to distant signals.

Standard rules and specifications should be issued by the State governing the construction and operation of interlocking systems, as varying conditions in so important matters as interlocking and signaling are not conducive to safety.

With this in view the Commissioner of Railroads has ordered a revision of the specifications hitherto on force in this State, in order that the protection at our crossings may be improved in uniformity and in accordance with all modern requirements for safety.

There seems to be no good reason why all railroad crossings at grade should not be protected in the most complete manner. The advancement in the art of interlocking and signaling

makes it possible to render the passage of traffic over such crossings and drawbridges entirely safe, and taking into consideration the measure of protection assured, the expense of installation and maintenance is entirely consistent.

Another menace to perfect signaling is the liability that the colored lens showing danger or caution, may be broken or displaced, thus displaying safety signal when danger signal should be exhibited. Considerable discussion has been had in the Railway Signaling Club,— of which I am a member,— over the feasibility of changing the standard signal colors, making white the danger signal; red, caution; and green, the safety signal; also, with reference to recommending reflected lights instead of colors at night.

The change from what has been standard practise for so long was considered too radical, so a number of railroad companies outside our State, have adopted a combination lamp, showing two lights of different colors from one flame. The absence of either or both is regarded as a danger signal, and the scheme gives good satisfaction.

It will readily be seen that there are good arguments in favor of a change in colors for fixed signals, at night especially; but if consummated, it must be done by some means gradually and with great care and judgment.

Lack of time forbids going into details regarding construction of approved interlocking plants. For operating switches and derails the facing-point lock, which requires two lines of pipe, is gaining favor over the switch and lock movement, and though the cost of installation is greater, the expense of maintenance more than makes up the difference. Many signal engineers now consider it feasible and economical to operate all home signals by pipe line instead of wire, pipe being more positive in adjustment and action.

We shall be glad to receive suggestions and advice from any of the members of this association regarding any improvement in this class of mechanism, or on any subject upon which interchange of opinion must prove beneficial to all. I shall also be glad to take up a discussion on any of the points herein involved with any of the members by letter, and at our leisure.

ELECTROLYSIS.

R. C. SMITH.

The first record of a series of systematic tests on the influence of stray currents from electric roads, was made by Mr. I. H. Farnham in Boston. His results can be found in the transactions of the Institute of Electrical Engineers of April, 1894; but these experiments were mainly made on telephone cables, carried in subways, touching the ground only at widely separated points, and nowhere coming sufficiently close to the track to permit the passage of more than very small currents.

Mr. Farnham's tests were made with a view of ascertaining the potential relation between the conductor and the ground. It was assumed that this potential relation determined the passage of a current to or from the conductor.

In July, 1894, the San Francisco Gas Co. took up this matter of electrolysis, and made a very complete examination of the conditions of the buried pipe systems. The work was performed by Mr. Stuart Smith, assisted by Mr. Frank P. Adams. They tested between five and six hundred points, both along the line of the electric road and in the outlying regions, into which it was found the electrical influences extended. The tests consisted in determining the potential relations between the buried pipe systems and the track, between the two pipe systems (gas and water), and between the pipes and the earth. The conclusions to which these tests led, are that everywhere along the line of an electric road, we find a potential difference between the track and the pipe systems.

In general, the positive of the dynamo is connected to the trolley and the negative to the track; with this arrangement there will be found a region of greater or lesser extent, depending upon circumstances, where the pipes will be positive to the track. This region is commonly called the "Danger District." The direction of the flow of the current in this district is from the pipe to the track through the soil, and hence we have the

corrosive action. Corrosion is much less than sensational newspaper articles would lead one to suppose, but it is steadily going on and may be expected to cause much trouble, unless means are adopted to prevent it. However small the difference of potential may be between the pipe and the rail, corrosion will take place, depending entirely upon the strength of the current and the nature of the salts present in the soil about the pipes.

Corrosion will always take place where the resistance of the earth is low enough to make a flow of current possible.

John C. Lee, of Boston, has experimentally caused the corrosion of lead and iron pipes, by a difference of potential of $\frac{1}{100}$ of a volt. With a current flowing, a very small quantity of salts present in the soil is sufficient to start the electrolytic action, and this will continue as long as the current flows.

To determine this danger district, volt-meter readings should be taken between pipe systems and rails. Too much dependence should not be placed upon volt-meter readings alone, as the readings obtained may be an electrostatic one.

Attention is also called to the fact that every pitting of pipes does not mean electrolysis from railway currents; it may be due to impurities in the pipe which set up local electrolytic action. Baltimore experienced trouble of this kind before any electric railways were in operation there.

To overcome this electrolytic action, several methods have been tried. Obviously the best way would be to make a complete metallic circuit insulated from the earth; that is, a double trolley wire system. But owing to the greatly increased cost of construction, this method has been adopted in very few cities. If the rails are to be used as a return conductor, their cross-section should be sufficiently large to have the same conductivity as the trolley. Almost all the electric roads of to-day have rails of sufficient cross-sectional area, the only difficulty being in securing a good electrical continuity of the track. To obtain this, one method is to employ rail bonds. At first an iron bond was used, but this was soon replaced by a copper one. It was made from two to three feet in length and was

secured by drilling the end of the rail and riveting the bond into place.

Modern practise is to make the bond as short as possible (from six to eight inches), attached to the ends of the rail either by a screw connection and then soldered, or by expanding the bond in position. This bonding must be carefully done, in order to obtain the required electrical continuity of the rails. The rail-bonds should be placed in such a manner as to allow of frequent inspection.

In several cities electric welding has been used, thus forming a continuous rail with no breaks. This produces a very good return as regards the electrical features, but there are mechanical objections which prove that this method is not successful. A process of casting together the rail ends, has also been tried. A mold is placed around the rail ends and melted iron poured in, which, on solidifying, forms a solid block that fuses the rail ends together. A better electrical joint could not be obtained, but here again we are not certain about its mechanical success. Connection only at the power-house to water or gas-pipes will not insure their safety. Until either of these methods of welding and casting rail ends together have been demonstrated to be a mechanical success, the bonding of rails will be the best method to use.

But the bonding of rails or the providing of a metallic return of equal area and conductivity to the out-going wire is insufficient wholly to prevent electrolysis.

Mr. Farnham recommends that through the entire "danger district" all pipes that are in danger should be connected by means of large copper conductors to the grounded side of the dynamo. It is better to use a separate conductor for each set of pipes to be protected.

All connections between the pipes and rail, or rail-return outside of the "danger district," should be carefully avoided. There appears to exist in the minds of some an impression that the danger of electrolysis is only present in large cities. But there are cases on record where iron pipes have been destroyed by electrolysis with no more than six cars in operation on the road.

The electrolytic action may be minimized to such an extent that it will not be a dangerous factor, by properly bonding the rails, by having a good track construction, and a return circuit of ample capacity, and by connecting the pipes in the "danger district," to the negative side of the dynamo.

Frequent voltage readings between pipes and earth should be obtained and such changes in the return conductor made as the measurements indicate.

In closing, I can do no better than use words which will remind you of Patrick Henry: Eternal vigilance will be the price of pipes and cables where conditions favorable to electrolysis exist. I am indebted to W. J. Melcher, E. E., for some of the data furnished in this paper.

Colonel Muenscher: How would concrete put under the track do?

Mr. Smith: The best thing is a double trolley wire, a return circuit, but the cost is so great that not many use it. The next best thing is to use concrete. We do that to a great extent. There is only a small "danger district," and that is right around the power-house, where the pipes will be affected. There is no danger when the current flows to the pipes; the danger is in the opposite direction. We have a circuit, and in order to complete it some of the current goes back along the track, and some goes through the earth, and some goes back upon the pipes; but where it leaves the pipes, that is where the danger exists. There is no danger from a current coming from the track to the pipe; it is where it leaves the pipe to the power-house. When it leaves the rails, the iron is deposited on the pipes; when it leaves the pipes, the iron is taken from the pipes and deposited on the rails.

Mr. Wells: I have given this matter some attention, and it always appeared to me that the greatest source of trouble was poor bonding on the rail. We are interested in a street-railway; and out in the country, we have been troubled by thieves cutting the copper bonding and taking it away to sell.

Then there is danger of poor workmanship in fitting the bond, so you don't get a contact.

MR. APPLETON: I believe the bonds are broken by the vibration of the track; they don't have the track so that it won't vibrate.

THE INTAKES OF THE GREAT LAKES.

THOMAS W. BARRALLY.

The matter here presented is the result of some investigations begun by the writer in 1895 to secure data which would guide him in the design of the new intake and pier for the North Tonawanda water-works. The principle, that we may be guided by failures as well as by successes, is especially applicable in the study of the problems here presented. Nowhere has success resulted from long experience with overcoming obstacles more truly than here.

The cities and villages taking their public water supplies from the Great Lakes have encountered great difficulties, and many failures have resulted. The ever-increasing danger from sewage contamination makes it necessary to carry intakes out to greater distances to obtain a purer supply.

The margin of the lake is often shallow and carries a large amount of fine sand in suspension during violent storms. The mouth of the intake is turned up and often extended upward toward the surface to avoid sand and other objectionable matter stirred up from the bottom, but in escaping this danger, a new one is encountered. In the cold weather when the temperature is near zero, the water of the lakes becomes filled at the surface with fine needles of ice generally called anchor-ice. These collect in masses and clog up the ports of cribs, causing stoppage and water famines. In many of the small towns where intake pipes have been laid on the sand bottom, shore ice has been a source of danger.

At Fort Sheridan, Ill., a spiral welded pipe was torn open and filled with sand, and it was proposed to relay it with flexible jointed pipe. Flexible jointed pipe, on account of its weight and strength of joint is far preferable for conditions similar to the above-cited one. The better way to construct an intake, however, where danger from shore ice or shifting sands

or any similar causes appear, is to lay it in a deep-dredged channel where its security cannot be menaced.

The great cities have in nearly all cases constructed tunnels for their intakes with expensive cribs, yet they have not escaped the dangers of anchor-ice stoppage. Buffalo and Chicago in particular, have encountered serious difficulties.

The city of Buffalo takes its supply from the Niagara River near Lake Erie through an unlined tunnel 6′ in diameter, terminating in a shaft over which is erected a crib of timber with masonry above the water-line. The crib is rectangular with a sloping nose protected with steel. It has two ports 5′ x 3′ in diameter, admitting water into its well. These ports are in the sides with their sills 6′ from the bottom. The rapid growth of the population of the city has made unusual demands on the capacity of the works. During the winter of 1896, it has been reported that the city was pumping one hundred million gallons of water daily, that the level of well was greatly lowered, and water famine imminent. The high velocity developed in the tunnel carries large quantities of slush ice, which collects in the well and is scooped up by men with wire nets, to prevent choking the pumps. Anchor-ice collects at the crib ports, and gives trouble if not removed as fast as formed.

A new tunnel has lately been constructed by the side of the old one, and the crib extended down stream with larger crib ports for the inlets to the new tunnel. The level of the well has risen nearly to the river level, and little or no danger is feared the coming winter.

Chicago takes its supply from Lake Michigan through four tunnels with cribs. The dimensions of these tunnels are as follows: one system having a tunnel 8′ in diameter merging into two, 6′ in diameter; one having a tunnel 6′ in diameter; a third having two branches of 5′ and 7′ in diameter; the fourth has one tunnel 6′ in diameter. These tunnels are lined with brick and extend to points two and four miles out in the lake. They receive their supply through an iron shaft 9 feet in diameter, extending above the water surface in wells enclosed by polygonal cribs of timber below and masonry above

the water-level. Ports are constructed through the timber work, admitting water into the wells at depths varying with the different cribs.

The two-mile crib has given the most serious trouble. The crib is pentagonal, enclosing a well measuring 22′ on each side. There are two shafts and 4 crib ports 4′ high and 5′ wide. Surrounding the crib, except for a space of 30′, is a breakwater; in the channel formed by the latter, the water passes from the lake to the inlets.

Mr. E. B. Guthrie, former city engineer of Buffalo, in a report to the Board of Public Works of that city in 1895, has described the conditions he found, as follows: —

"On the day of my visit, there was a tug with stern in the opening and men poling the ice into the outward current created by the wheel of the tug trying to force the ice from the channel into the lake; notwithstanding a large timber beam was placed across the opening, floating ice found its way into the channel. At this time there were nineteen men on the crib, an increased number, of course, to prevent obstruction from ice. The main difficulty consisted in keeping the channel between breakwater and crib, free from floating and slush ice and the ports free from slush- and anchor-ice.

Chains are laid through the crib ports, through which they are dragged back and forth to keep the ports clear, and in addition, three of the ports are supplied with iron stand-pipes slung vertically outside. The lower ends of these stand-pipes are bent at right angles and drawn down, forming a nozzle of smaller diameter. There are two steam-pipes on this crib from which hose are carried to the upper ends of these stand-pipes, and water forced through them at 140-pound pressure. These streams are directed to all sides of the ports, forcing the ice into the well. From the well, a part of the ice was scooped up by nets, wire baskets, etc., while a greater part found its way into the tunnels. The water in the well was in a continual swirl, showing the rapid draft into the tunnels. The latter conditions led Mr. Guthrie to conclusions stated in the case of Buffalo, above described, and to be hereafter discussed.

The 4-mile tunnel and crib was constructed later, being completed in 1892. It has two 6′ branches 13,420 feet long, with a single branch 8′ in diameter, 7,950′ long, connects with the crib 4 miles from shore in water about 46′ deep. The crib is similar to the 2-mile crib in form and general features. The ports are 6 in number, 5′ x 5′ with sills 5′ above the bottom of the lake. The remaining systems at Chicago are of the same type as is also that of Cleveland. No serious troubles with ice have arisen in these last-described systems, due principally to the greater area of ports as compared with the area of the tunnels, and also to the greater depth of crib ports.

I now describe briefly one or two prominent types of a different character.

Rochester, N. Y., takes its supply from Hemlock Lake. Water is taken from a submerged timber crib and through a 5′ steel intake pipe, 1,550 feet in length, which connects with a brick conduit 6′ in diameter and 12,000 feet in length and 26½ miles of 38″ in steel conduit. The crib is square, 16′ on each side and 10′ high. Its top is 26 feet below the surface of the lake.

Syracuse takes its supply from Lake Skaneateles through a 54-inch steel intake and submerged timber crib, 16′ square and 12 feet high. Its intake, 54 inches in diameter, is laid in a dredged channel, and the crib is located in 38 feet of water, 6,410 feet from the gate-house on the shore of the lake. Three analyses of water taken directly over the crib, one at the surface, one half-way down, and one at the crib show that water at the crib is the best in quality, that at the surface comes next, while that half-way down ranked third in purity. The cost of the intake pipe was about $11.30 per lineal foot.

The city of Erie at present takes its supply from a land-locked harbor formed by a peninsula. Its intake is a cast-iron pipe 5′ diameter, terminating in a temporary crib, and it is proposed to extend the same across the peninsula and 3,500 feet out into Lake Erie to a submerged crib 40′ outside dimensions and about 9′ high. Toronto also has adopted a submerged

crib and a steel intake in preference to a tunnel. It takes its supply from Lake Ontario.

These types vary widely from the first-described systems at Buffalo and Chicago, the principal features being the adoption of steel intakes instead of tunnels and the use of the submerged plan of crib. The use of steel for large water-supply conduits has increased very rapidly of late. It has been adopted in places where bad materials have made the construction of tunnels too expensive or otherwise impracticable. Steel has also been quite extensively adopted for large conduits on gravity systems and force mains.

No trouble has been reported from anchor-ice from any of the last-mentioned places.

It will readily be seen that the form of cribs so far employed are of two distinct types: the one first built at Chicago, and later copied at other places, rises above the surface of the water as distinguished from the low submerged cribs adopted at Toronto and other places. It was undoubtedly adopted because of its greater adaptability to control the tunnels. It is large and massive, having great weight and stability and great power to resist impact. Its great defect is that it assists in creating the trouble from ice, by reason of the masses of ice collecting and adhering to its sides. In its evolutions from the first built, it has been improved by increasing the size of the inlets and wells as compared with the size of the tunnels and by increasing the depth of the inlets.

The submerged type of intake is probably the best, under most circumstances. It should be located in deep water with its top far enough above the bottom to avoid sediment or other objectionable matter, and far enough below the surface to escape the dangers of slush- and anchor-ice. It should have large openings of great combined area compared with the area of the tunnel or intake pipe.

The experts, Messrs. Rudolph Hering, Geo. H. Benzenberg, and Desmond Fitzgerald, employed to report on the water-supply of Cleveland, referring to the form of intake at the terminus of the new extension, say: "We firmly believe

that a submerged crib should be adopted. When a crib is designed to extend above the surface of the lake for the purpose of giving access to the tunnel and to draw water at different levels, it must be of the most substantial character. Small and weak cribs have proved a source of anxiety and expense, and even where a large structure is used surmounted by heavy masonry walls, it acts as an obstacle to the free passage of ice. A submerged crib, on the other hand, say 10 feet in height in 53 feet of water, allows the free passage of ice on the surface, and uninterrupted access for the water. In a lake the size of Lake Erie, stagnation effects could hardly occur in such a position, and the water will always be of excellent condition near the bottom. It is important that the velocity of the water when it enters the crib should be reduced to but 3 or 4 inches per sec. and that the area of ingress be sufficient to produce this result. The evident consequence will be that less floating matter will be drawn into the crib."

The theory of the formation of anchor-ice has been given by Mr. J. B. Francis, C. E., in "Transactions of American Society of Civil Engineers," Vol. 16, page 171, and Vol. 10, page 12, and is as follows: When the temperature of the water is at freezing and that of the atmosphere below freezing, ice forms at the surface and becomes needles or anchor-ice, and is carried down by a descending current. It is also necessary for its formation that the water up stream should be open or uncovered with ice. This theory seems to accord with the facts as given in the laws of freezing, in text-books on physics. Mr. Guthrie in the report above referred to says: "If this theory be true, a reduction in the velocity of an inflowing current, quantity remaining the same, would diminish the stoppage of anchor-ice."

The enlargement of areas of crib ports would accomplish this result, and the deepening of the ports would make it necessary for the water to travel a greater distance from the surface to the ports. Water, unlike other liquids, contracts as its temperature rises from 0° to 4° C., at which point its volume is a minimum, and therefore its density a maximum. This

was first established by an experiment by Hope. As water grows colder, its density increases and it sinks to the bottom. This process goes on till all the water in the lower port has attained a temperature of 4° C. equal to 39° F. (nearly), where it remains constant. This fact seems to be a further confirmation of the necessity for placing the crib ports deep, and also to demonstrate the superiority of the submerged type of intake crib.

Various devices have been tried to mitigate the dangers of ice stoppage on structures already in use. On the old intake at Milwaukee, a boiler was placed at the crib and a 2-inch steam-pipe carried down into the intake. When ice forms, steam is turned on and the trouble ceases in a short time.

The Falcon Rotary Strainer is a patented device for preventing ice stoppage. It consists of a cylindrical screen mounted on an axle, so as to revolve freely in a rectangular box built on the mouth of the pipe. Buckets are attached to its radial arms with their mouths opening downward. A pipe from the shore delivers compressed air which enters the buckets, displaces a portion of the water, and exerts a lifting force on them. As each bucket rises, it is inverted and its charge of air escapes. It is stated that it has been in successful use at Evanston, Ill., and other places for several years.

Mr. Frank Chase, engineer of the Tonawanda (South Side) Pumping Station, has put air pipes connecting the air chambers of the pumps with the intake. A valve is inserted on the intake pipe between the point of connection of the air pipe and the well. When operated, this valve is closed, and air is forced into the intake, reversing the flow momentarily in the latter, and producing an agitation of the water in the well.

The above statements embrace about all the vital points the writer has been able to gather on this subject. The new intake at Milwaukee designed by Mr. Geo. H. Benzenberg, seems to have embraced all the good practise indicated in the discussion, and to have avoided all the bad. A tunnel $7\frac{1}{2}$ feet in diameter has been driven out to a point 3,200 feet from shore, at which point a 12-sided crib is placed with 4 ports $5' \times 3\frac{1}{2}'$ for

emergency only. From this crib 2 lines of pipe 5′ in diameter are laid to a point in 60 feet of water, where are placed submerged cribs.

The writer in designing the crib for North Tonawanda, lately completed, desired to use the submerged type of intake crib. One of the conditions governing the use of this type of crib, however, is that in a navigable stream it should be deep enough to present no obstacles to navigation. The pier is located in water 16 feet deep, just west of the main channel of the Niagara River. The plan adopted was a submerged crib with up-stream crib and pier for protection. The whole was combined in one structure with the intake in the rear 20′ x 20′ in dimensions, taking water from the top of crib 5 feet above the bottom of the river. It has large area of inlet compared with the area of the intake pipe; and great weight and stability to resist wave and ice action. The intake is a steel pipe 4 inches in diameter, laid in a deep dredged channel. The cost of the pipe was $11.50 per foot, and $8,000 for the pier.

The question of adoption of form of intake, whether it shall be a tunnel, or a cast-iron or steel intake, is one that should be carefully worked out for each locality, taking into consideration the cost and the material to be encountered. It is the writer's opinion that a tunnel is the cheapest and best form of construction for a great city where large volumes of water are used. The experts reporting at Cleveland, above referred to, considered that cast-iron mains of the required capacity sunk in the bed of the lake would be more expensive than an 8′ foot tunnel, and they recommended the construction of the tunnel.

Steel intakes, on account of their light weight, and consequent ease in handling and laying, and their great strength, are very economical, being cheaper than cast-iron. The question of their final durability depends upon ability of the coating to protect the shell from oxidation. Asphalt has been used more than any other material for a coating. Great difference of opinion exists as to the life of a steel pipe under such conditions, and the question cannot be definitely settled until more thorough information exists.

Mr. Williams: The paper shows the result of a very commendable amount of investigation and study into the somewhat limited literature of the subject, more, in fact, I think than I myself have done. Anchor-ice has been very generally troublesome to the northern water-works. This ice sometimes occurs at a time when the water is moderately warm, and therefore, of less density than the ice which may form on the surface, due to a sudden cold snap. The ice, being heavier than the water, sinks and collects on the bottom. As the water gets colder, the ice may rise again to the surface, if it has not been melted by the water. In very cold weather the water may be at about the freezing point, and the ice forming on its surface may reach a temperature enough lower so that it will sink even with the water at its greatest density. Then the ice does not melt, and then is when the trouble occurs. The *Engineering Magazine* for May, 1895, Vol. IX, page 397, contains a brief, but very complete discussion of this subject by Mr. Frank S. Mason, of Walden, Mass. He there shows an arrangement of baffling screens to prevent its accumulation at an intake.

Detroit formerly had much trouble with anchor-ice, even from the earliest periods. The later intakes were guarded at the mouth by screens of ash slats $\frac{3}{4}$ of an inch wide and set $\frac{1}{2}$ an inch apart. Although the capacity of these screens was several times greater than that of the pipe, the ice frequently stopped them up. In 1894 every alternate slat was removed, making the openings $1\frac{3}{4}$ inches instead of $\frac{1}{2}$ inch in width. Since that time there has been no trouble.

Windsor, Ontario, during the past summer put in a new intake, which was provided with a coarse strainer of iron bars, arranged 3 or 4 inches apart, and of such capacity that the flow through it would never be at a greater velocity than that of the river. Although with the finer meshes and smaller section of the old intake, anchor-ice was an almost continuous annoyance during cold weather, thus far in two months of this winter there has been no trouble.

In designing their work provision was made for ice should it be carried through the intake, by constructing a well into

which the intake discharged near the bottom, while the pump suction was taken out a few feet higher, and a screen whose sill was on a level with the bottom of the suction was put in across the well. Any ice that comes through the intake is deposited in the bottom of this well which is near the pump-house, and can be readily scraped out or thawed by a jet of steam.

Steel or wrought-iron pipe for intakes, terminating in some form of submerged crib or strainer head, has been used in Detroit since 1857. The oldest of the present ones was put in about 1875, and is 5 feet in diameter and 1,100 feet long. It is of boiler-iron, about $\frac{5}{8}$ inch thick, and the joints go together like stovepipe, and are held by bolts, connecting lugs on the two sections. It appears to have been coated with a bituminous paint, and is still in an apparent good condition.

For intakes along sandy shores where the water is free from sediment other than sand, I would favor a filter-gallery, constructed parallel with the shore and a few feet inland, by which the question of anchor-ice and storm effects are wholly eliminated, and the water can be obtained free from sediment and undesirable impurities. Many towns on our Great Lakes have expended in cribs and intake pipes four times the sum required for a filter-gallery, and are not to-day obtaining either as reliable or as pure a supply as they would from the filter-gallery. This is a form of construction that our water-supply engineers would do well to investigate, and one that is extensively used in the works of New England, where the science of water-supply engineering has reached its most complete development.

The author's design for the crib at North Tonawanda is to my mind a very satisfactory solution of the problem; the openings in the top make one of its most interesting features, which I believe to be new and considerably in advance of the side inlet.

Mr. Brigden: I would like to say a word about the use of light steel or iron pipe. The great trouble in Toronto, where hey have had more experience than anywhere else, seems to

be that the pipes rise to the surface because of stoppages, and the water being removed from the pipes, the accumulation of air inside makes the pipes light enough to rise to the surface. I know that that can be done, because we have a revolving piece of pipe at our intake, and we need only to start up the pump a few minutes, if the water cannot get through, before the pipe begins to rise out of the water. It will float just as well as when first taken out from the shore and put together. That will always be something against any light pipe.

Mr. Wells: This pipe was laid in a dredged channel. It varies from about 16 feet to 20 feet, going down to about 27 feet in the deepest place, so there was enough material got on top of the pipe to hold it down, no matter how buoyant it became.

The problem of combating with ice at Buffalo and Tonawanda, immediately adjoining North Tonawanda, was uppermost in the minds of most people at North Tonawanda. This was designed to get a slow flow through this 18 by 18 opening, which is grated, into the four-foot pipes. It was a problem that engaged Mr. Barrally's attention a great deal. You know that North Tonawanda is a great fire risk, having more lumber piled on the same area than anywhere else in the United States. The full capacity of the pumps is about ten million gallons. This means about 1.15 feet per second. You see that the flow into the grating is very small in comparison with the flow into the pipe, and by that means he hopes to keep it free from anchor-ice and slush ice. The Michigan Pipe Co. were the contractors,—you will pardon me for saying a word about ourselves,—and I was there as engineer in charge of the construction for the pipe company. I had opportunities to discuss this matter a great deal with Mr. Barrally. At one time the query came into my mind as to whether it would not have been better to continue the crib-work out here, and have the water come in from the sides; it would have to come in from the upstream side. After studying that for some time, I came to the conclusion that this was the better form, because this opening would be of less area to begin with, and then this area, this

part of the opening, would be clogged with slush ice from the lake. I believe that construction is about the best that can be adopted for that locality.

Another problem presented itself to Mr. Barrally. The old intake was right in the current of the stream, and where it was plain that after every rain the street water and surface washings from Buffalo came down and contaminated the water. He studied that for some time and noticed that after every rain the muddy water which came from the streets, evidently hugged to the east shore of the Niagara River. As a result of that investigation he carried this pipe out 1,200 feet in the river from the shore. The size of this pipe would be 4 feet by 1,200. I don't think he meets with any difficulty on account of his design.

President: I want to call attention to the system of water-works that the town of Petrolea put in last year, which takes the water from Lake Huron, a distance of 12 miles. They have only a 12-inch pipe for that distance, and their pipe is extended out into the lake something like 1,200 feet, not, however, into the line of navigation. It is protected only by some piles, and laid in a light trench. So far as I know, it has worked successfully for the year. Mr. Willis Chipman, of Toronto, the engineer of the water-works, discusses this in the last Canadian Society report. It is interesting as showing how far inland towns can be supplied from the Great Lakes.

Mr. Brigden: Have they any storage capacity at Petrolea?

Mr. Slocum: They have a stand-pipe there.

Mr. Riggs: I was interested in Mr. Wells's remarks about the side which the current takes. There has been quite a little done in that matter in connection with the Toledo water-works. We have the best water in the world, as some one said, but it is difficult to find the water. For about 11 months of the year it is a regular coffee color. A great many people have advocated going to the lake for our water-supply. If we go to the nearest point, Maumee Bay, those who have the matter in charge have come to the conclusion that it would be necessary to go beyond the light, a distance of 33 miles into the lake, to

put a pumping station. One of the engineers who has given the matter some thought and has made some study of the currents in the lake, maintains that the current sweeping around the end of the lake from the Detroit River will eventually shut us off from any supply from the lake.

Mr. Appleton: If you have a sufficient intake, it ought to influence to a certain extent the course of the current, drawing it toward the intake.

CONTRACT VERSUS DAY LABOR.

E. W. MUENSCHER, MANISTEE.

The question not infrequently arises whether it is the better policy for a municipality to have its public works constructed by contract or by day labor. As bearing upon this question, the recent experience of the city of Manistee may not be entirely without interest.

Up to the summer of 1893 this city had followed the general custom of having its pavements and sewers constructed entirely by contract, except that it purchased all sewer-pipe directly from dealers. During that summer, owing to an accident at the factory which was furnishing the city with pipe, the delivery of the material for a sewer contract of considerable amount was delayed until the time fixed for the completion of the contract had expired. The contractors, who had taken the work for a sum several hundred dollars less than any other bid, had in the meantime become convinced that they had made a mistake, and took advantage of this delay to refuse to execute the contract; and the common council being somewhat in doubt as to its legal rights in the case, concluded to try the experiment of doing the trenching and pipe laying by hired labor under the direction of the city engineer. This was done, and the result was the completion of the work for about fifty dollars less than the very low contract price. The success of this experiment was so satisfactory to the council, that since that time all the public work of the city, with the single exception of a large steel bridge, has been done by hired labor under the direction of the city engineer.

A few examples of this work may be of value for comparison with similar work which has been done by contract.

A sewer constructed in Fifth Street and Fairview Avenue in 1896, 1,424 feet in length, with an average depth of excavation of 10′ 9″, and including five manholes and nine catch-basins with the connecting 6-inch laterals, cost as follows: —

582	Lineal Feet of 15″ Sewer Pipe	@ $0.28	$162.96
646	" " " 12″ " "	@ 0.19	122.74
94	" " " 9″ " "	@ 0.12½	11.75
224	" " " 6″ " "	@ 0.08	17.92
20	Pieces 15″ x 6″ Y Branches	@ 1.29	25.80
20	" 12″ x 6″ Y "	@ 0.88	17.60
3	" 9″ x 6″ Y "	@ 0.57	1.71
9	" 6″ Elbows	@ 0.28	2.52
18	Barrels Cement	@ 1.25	22.50
11,052	Brick		75.60
9	Basin Covers	@ $6.00	54.00
5	Manhole "	@ 9.00	45.00
4031	Feet B. U. Lumber	@ $6.50	26.20
	Kerosene		.60
	Labor		451.75
	Assessment, etc		13.66
	Total		$1,052.31

The total cost per lineal foot was $0.738, or for trenching and pipe laying alone, $0.336.

The excavation for this sewer was entirely in dry sand, giving no trouble on account of water, but requiring curbing throughout its entire length to prevent caving.

A sewer in Ramsdell Street constructed the same season, 1,223 feet long, of which 879 feet was of 12-inch and 344 feet of 9-inch pipe, with 3 manholes and 7 catch-basins, cost for pipe, brick, and cement, $330.80; covers, $69; lumber, $7; labor, $270.40; and assessment, $12; a total of $689.20, or $0.563 per lineal foot, or $0.223 for trenching and pipe laying alone. The average depth of excavation for this sewer was only 7′ 6″, but for most of its length the lower two or three feet was in quicksand full of water, requiring close curbing and the use of an iron box to enable the pipe to be laid.

An alley sewer constructed in 1895, 792 feet long of 9-inch pipe, with two manholes, but no basins, and with an average depth of excavation of 9′ 5″ in moderately hard clay requiring no curbing, cost for pipe $99.60; cement and brick, $19.55; covers, $18; labor and repairs of tools, $153.85; assessment, $6; a total of $297, or $0.375 per lineal foot, or $0.195 for labor alone.

A single example will show how the same system worked in its application to paving. In 1896 the city laid on Smith Street 1,147 square yards of 6-inch cedar block pavement. The curbing was of 4″ x 18″ white pine, the flooring of 1-inch hemlock on sand, the gravel for filling the interstices of a very superior quality brought from the Manitou Islands by schooner, at a cost of $1.50 per cubic yard. The city bought the cedar in posts 100 inches long, hired the power and machinery for sawing them into blocks, and did all the work with the ordinary street force. The entire cost was,—

2,800	Feet B. U. Curbing	@ $15.00	$ 42.00
11,164	" " Flooring	@ 6.50	72.56
50	Cords Cedar Posts	@ 4.90	245.00
18	Cubic Yards Gravel	@ 1.50	27.00
	Rent of Power		28.05
	Sawing Blocks		22.75
	Labor of men and teams		236.64
	Total		$676.00

The cost per square yard was 59 cents. This includes 460 cubic yards of sand filling, which was hauled about one-half mile. Allowing 8 cents per yard for loading and unloading and 12 cents for hauling, would deduct $92, and leave the actual cost of the paving proper, including the curbing, about 51 cents per square yard; or, leaving out the curbing and the labor of setting it, about 46 cents per square yard. This is the lowest cost that I have ever heard of for similar work.

The prices previously paid by the city for contract work were for paving alone per square yard 83½ cents in 1884, 72½, 61, and 70 cents in 1886, and 48 and 50 cents in 1887.

The same policy was pursued during the season of 1897, with equally favorable results. During this season four blocks of River Street were repaved with 6-inch cedar blocks to the total amount of 8,170½ square yards. As this street is subjected to much heavy teaming, the council concluded to use 2-inch flooring, except between the rails of the street-railway, where 2-inch plank would have been too thick. This 2-inch flooring cost 75 cents per 1,000 feet less than the 1-inch of the

year before, and part of the gravel used, cost 25 cents per cubic yard less, but most of the cedar posts cost one dollar per cord more. Wages and team hire remained the same, labor being $1.50 and team $3.50 per day. The only excavation necessary was sufficient to make room for the increased thickness of the flooring, but the tearing up and hauling away of the old blocks, flooring, and curbing added considerably to the labor account.

The total cost of the work was as follows: —

105,325 Feet B. U. 2″ Hemlock Flooring	@ $5.75	$ 605.62
22,638 " " 1″ " "	@ 6.50	147.15
18,576 " " 4″ x 18″ White Pine Curbing	@ 15.00	278.64
353½ Cords Cedar Posts	@ 5.90	2,085.65
23½ " " "	@ 4.90	115.15
75 Cubic Yards Gravel	@ 1.50	112.50
87 " " "	@ 1.25	108.75
Rent of Machine and Power ($6 per day)		155.70
Labor Sawing Blocks		152.27
Labor and Team Hire		910.58
Total		$4,672.01

Or 57.1814 cents per square yard.

The elements of this cost per square yard would be,—

Flooring	15⅝ Feet B. U. Lumber, cost	9.213	cents.
Curbing	2.273 " " " "	3.410	"
Posts	0.04614 Cords "	26.936	"
Gravel	0.02 Cubic Yards "	2.708	"
Rent of Machine and Power	"	1.905	"
Labor Sawing Blocks	"	1.863	"
Labor and Team Hire	"	11.145	"
Total		57.18	

One cord of posts laid on an average 21⅜ square yards of pavement, and it cost 81.69 cents to saw it into blocks. The rent of the machine and power for sawing the blocks was high, and it would be economy for a city to own them itself, if it was expecting to do much work of this kind.

Two sewers were built during the same season, one in Sixth and Maple streets, 799 feet long, of which 308 feet were 12-inch and 491 feet were 9-inch pipe. The average depth of

excavation was 9½ feet and there were 5 manholes and 5 catch-basins. With the exception of a few rods at the upper end, which were in clay, the trench was in loose, dry sand, requiring close curbing. The cost of construction proper was, for sewer-pipe, $108.24; brick and cement, $39.93; covers and steps, $48.75; lumber, $11.39; labor, $202.18; total, $410.49, or 51⅜ cents per linear foot, or 25.3 cents for labor alone.

The second sewer was built in Lincoln street, and was 852 feet long, of which 271 feet were 12-inch and 581 feet were 9-inch pipe, with 2 manholes and 4 catch-basins. The trench was of an average depth of 10.7 feet, and was entirely through loose, dry sand, requiring close curbing for its entire length and giving a great deal of trouble by caving. The total cost of construction was, for sewer-pipe, $113.37; brick and cement, $43.02; covers and steps, $42.75; lumber, $11; labor, $214.88; total, $425.02, or 50 cents per linear foot, or 25.22 cents for labor alone.

The pipe cost at Manistee 12-inch, 15 cents; 9-inch, 10 cents; 6-inch, 5½ cents, per linear foot.

Nothing is included in the above statements for inspection, the time spent upon the work by the city engineer being otherwise paid for, and there being no other inspector. The street commissioner, a man of energy and experience, acted as foreman and superintendent, and the necessity for a special inspector was thus avoided.

The work done under this system has been the best that the city has ever known. The men employed having nothing to gain by doing poor work or putting in poor material, and anxious to retain their positions in these days of scant employment, have done their work faithfully; the engineer, having no one to bribe him to be blind or deaf, or with whom he could secretly share the profits of a contractor, has perforce been honest; and the city has saved the profits to which a contractor would have been justly entitled, and escaped the tricks to which too many of that class of men are tempted to resort.

It is true that the prices of materials have been unusually low for the past two or three years, which will account in part

for the low cost of these works, but this does not apply to the labor account as the city has not reduced the wages of its street force.

While this system has worked so satisfactorily in Manistee, it does not necessarily follow that it would work equally well everywhere else. Probably in the larger cities, where corruption in the public service is so generally prevalent, it would not be successful. Stuffed pay-rolls would pile up the labor account, and private dickers with dealers in materials would fill the streets with broken or second-class pipe or rotten blocks. Perhaps there would be no greater losses from these causes than now result from the negligence or dishonesty of engineers and inspectors and contractors, but probably there would be little if any saving. Neither could this system be employed in the construction of steel bridges, in dredging or other work requiring the use of expensive machinery, which must necessarily be done by contract. But for most kinds of work and in the smaller cities, including nearly all in this State, there is no good reason why it should not be generally successful. Next to an engineer who understands his business and whose integrity is above suspicion, the one thing most needed is competent, honest, and faithful foremen, men who know how to do good work and feel some pride in doing it, who can handle men and get a fair day's work out of each one, and will make out honest pay-rolls.

Even in these days of fierce competition and lax morality, such men can be found or trained in any of our smaller cities, and when found, should be kept in the employ of the city as long as possible, regardless of political changes. In some of the smallest towns, where there is but little work for an engineer, he might often fill this position himself, with great advantage both to the city and himself.

Mr. Williams: I had a little experience in the summer of '89. I was called in upon a work let by contract to the lowest bidder. The successful bidder was apparently not accustomed

to that class of work. He absconded, leaving somewhere in the neighborhood of $1,800 unpaid labor bills and several more unpaid material bills. The city was forced to complete the work. This was in a small town of five or six thousand inhabitants. We went ahead and completed the work to the best of our ability, with a gang of men, part of whom had been employed on the work before and part of whom had not. The excavation was done by the cubic yard; a station being measured off, and a man assigned a station, which he was expected to dig before he got another. As soon as he was done with that, he could have another. There was no limit to what a man might dig in a day, and he was paid by the cubic yard for the excavation, according to the quality of the material; the prices ranged from 10 cents per cubic yard in sand to as high as 28 cents in the hardest clay. The summer was very hot, the ground mostly clay, and some of it as hard material as I ever saw handled, in fact some of it was so hard that we had to resort to miners' picks and steel bars, in order to work it. This may have had something to do with the result. The work involved the laying of water pipe, varying from 12 to 4 inches. There were bids from $5,342, the lowest, to $8,850. It cost the city about $7,521, or about $500 more than the mean of the bids. My personal impression is that the gentleman who obtained the contract put in a bid too low to make a reasonable profit. The other two bids of $6,421 and $6,821, the next higher, I think were legitimate bids, and had a reasonable margin in them for the contractor. In other words, I believe that the bids were made pretty near right for the work, and that the contractors would have made a margin which the city did not make, especially as the city had to purchase tools which were charged to the work. The result was that the margin went to the laborer instead of to the contractor; that was all the difference there was in that case. So I am not entirely agreed that in every case a marked saving would accrue to the city. Then, too, much will depend upon the foreman in charge of the work. I have found that men digging by the yard will vary more than 100 per cent. in the output of the same number of hours. By

day work these men both receive the same pay and the good man usually gauges his output by the poor one.

MR. APPLETON: I have had a little truck with this sort of thing myself. From 1883 for a few years our city (Lansing) worked by days' work, and because of it the cost of sewers was reduced just about one half. Just about that time there came a howl from a class of heelers, who are almost always, in cities, the contractors for these sewers. I have known a contractor to take a contract for a sewer when he did n't have credit enough to buy a shovel to commence it with. This work was not done by politicians. We did n't care a continental whether a man voted for Bill Smith or any one else, if he did a day's work. But there was this whine, and the contract system commenced again, and now after about four or five years, there is a howl the other way.

THE HORSELESS CARRIAGE.

RANSOM E. OLDS.

The question of the horseless carriage is a subject with which the people of the New and Old World have wrestled for over a century. As early as 1784 in a patent taken out by Watt, is a description of a steam-engine applied to a carriage. Two years later a steam carriage of this description was built and run near Cornwall by Murdock, Watt's assistant; in 1802 further experiments were made, but it was claimed that the wretched condition of the roads in those days made it impracticable, and further attempts were abandoned. Thirty years later attempts were again made to build a practical steam carriage, and some were run in England and Scotland; these carriages were, however, very heavy, weighing from four to six thousand pounds, but a good speed was obtained, in some cases as high as twenty miles per hour was said to have been obtained. The danger, however, connected with the use of steam, and the constant attention to the water, fuel, etc., made it impracticable, and with the exception of a few experiments from time to time, the horseless carriage was again obliged to take another rest. As we come to the close of the 19th century, we find the people waiting for something to take the place of the horse; the money that has been offered as prizes has been a step in agitating the question; in 1895, when the *Times-Herald*, of Chicago, offered a prize for the best horseless carriage, they were flooded with entries, but only about five were ready at the time, showing that a very few realized what was required.

At the present time we find two means of propelling the carriage, which is occupying the attention of the people, namely, electricity and gasoline; the word "electricity" meets with favor with a great many people, as it is so commonly used for various purposes and has done so much in replacing the horse on the street-cars; but we must stop to consider that it

is only used in the latter case as a convenient means of transmitting power from the power-house to the cars, and that were the electric cars to dispense with the trolley system, they would have been confronted with a different proposition in replacing the horse. We are willing to admit that, could the electric carriage be operated by a trolley and have the wire connected in any direction it was run, it would have no trouble in stepping to the front, but any means of storing electricity represents a great deal of weight, which is the greatest objectionable feature for the horseless carriage; any one that rides a bicycle knows the difference between a light- and heavy-constructed machine; this is true with a carriage but on an increased scale, and when eight to twelve hundred pounds are added for a storage battery, to say nothing of the motor (which will weigh as much as a gasoline motor of equal power), you have a heavy vehicle. The electric carriage has the advantage of an easy starting motor, as the connection of the current is all that is necessary, while with the gasoline motor, the motor must be turned over by hand in order to get the first impulse to start. The storage battery takes as long to be charged, when exhausted, as it takes to use the current; this is overcome in many cases, however, by two sets of batteries, but when the weight is taken into consideration, it is no easy task to charge them; then, again, they can only be used at a reasonable distance from an electric station, and in case of heavy roads they exhaust the current or power very rapidly; all these points tend to be a drawback to the electric carriage, and while they will be used to some extent, they will not come into general use, unless some improvements are made in storage batteries over what we have at the present time. In my estimation, the gasoline vapor motor is the main factor which has come to the rescue of the horseless carriage; there has never been a power which has stepped into general use so rapidly as the gasoline engine; and, as a manufacturer of gasoline engines for over twelve years, I can truly say that the demands for every use is wonderful; its great advantages make this demand. It is a power that you can turn to at any

time, and it is ready on a moment's notice to work to full power without further attention; this is why it is so desirable for carriage use; of course, manufacturers throughout the country jumped into the business without a thorough knowledge of what was required to make a practical first-class article, and it is a common thing to see engines of this type smoking at the exhaust and using twice as much gasoline as needed to do the work. Ninety-five per cent. of our gasoline motor carriages are experiencing trouble for want of a proper motor, the vital point; most of the horseless carriage inventors are without gasoline-engine experience, which is the cause of a great deal of trouble in getting a proper motor; there is smoke at the exhaust and twice as much noise as necessary. A carriage is a very poor place to experiment with a motor, it is too apt to compare favorably with a balky horse. In the Olds patent, the engine (which in principle is the same as is used for stationary work) has been substituted for the reach, and forms the frame of the vehicle; it is a single engine controlled by a governor, and everything about it is automatic, so that when the use of the carriage is desired, the motor is started and runs continuously without further attention regardless of stops, etc.; in case a long stop is made, the electric current, which ignites the charge inside the cylinder, is thrown out and the motor remains at rest, but while the carriage is in use, the operator does not need to give the motor the attention that a horse would require; of course, it is necessary that the carriage be guided, which will require some attention, but not as much as to drive a horse with enough spirit to keep pace with the carriage; the matter of high speed is not called for, nor is it safe. I remember well my own experience when driving; I used to watch the wheels of our carriage, and often got into the shafts myself to see how much power it would require; my decision was, that a 1 H. P. motor would make it hum. I designed several in my head, and if left to myself long enough without being disturbed, could get the idea together and give it a trial; in fact, I could almost see myself flying down the street. I finally settled on one design and got the materials together;

it was to be three-wheeled in order to steer it easily; I must of course get the machinery out of sight, never thinking that we did not try to get the horse or locomotive out of sight; the carriage body was constructed 18″ deep to leave room for the machinery, an engine and boiler of special design was constructed, and gasoline was to be used as fuel; all this was placed in the buggy body, back of seat. I sent to Providence, R. I., and got the finest cut gears made, to avoid the noise; about this time sixteen to eighteen hours represented a day's work, which was increased along at the last. In due time the finishing touches were made, and of course there was a crowd around to see it start, but I informed them that I would not try her till the next day, not saying anything about my intentions of being up before the birds, as I realized that I had a colt on my hands, and did not care to have too many spectators; next morning when the clock struck three (it being in summer), I was on hand, and got up steam ready for a start; at 4:30 the doors were opened and the road was clear; I mounted to the seat and pulled the lever; she moved slowly, but speed was increased as it went down the platform out of the shop; there was a slight raise, however, before crossing the sidewalk and she refused to ascend the grade, so I at once dismounted, and going behind, gave it a push to be remembered, which did the business, and it reached the sidewalk in safety; I again mounted to the seat; there was yet a descent to the street in my favor, so that I had but little trouble in reaching the road and running a block without a stop; at this point the efforts of the engine were exhausted, and an assistant was necessary, as it was getting quite light and there was no time to be lost: I secured two pushers behind, and, together with the engine, got it back without an accident, which ended my first trip in a horseless carriage. About this time I began to realize that to put the horse on the wagon to turn the wheels and draw the load, was quite a different proposition; later I put a 2 H. P. in the carriage, but no satisfactory results were obtained.

I experimented with this carriage for three or four years, and five years later built another, fitted with a 4 H. P., but it

was not back geared for hill climbing, and I dreaded the sight of a hill, although it could make fair time on good, level roads. I decided to build another of this type, but as business took so much of my time, it was delayed, and in the meantime we brought out our vapor gasoline engines, which I at once realized were just the thing for the horseless carriage; the immense demand, however, for the engines interfered with my further attempts at the carriage till 1896, when I realized that I ought to make a move at once in this direction, or all my former experience would be fruitless; I at once set about my present carriage, which was completed in June, 1896, and has been in constant use ever since, and during the past one and a half years has proved itself to be entirely satisfactory and perfectly practical. It is always ready on a moment's notice; instead of hitching up a horse in the ordinary way, all one has to do is to turn the motor over to draw in a mixture of gasoline and air, which is ignited inside the cylinder by an electric spark, and the engine at once starts and runs continuously, so that the operator has only to throw the lever to different points to back, stop, or start the carriage without any reference to the motor or mercy on the horse; especially when it is ninety in the shade, when flies and dust are unbearable, you have only to turn on a little more speed to secure a breeze and leave the dust behind. When through using, you have only to throw out the electric switch and the horse is taken care of till needed again. I can see no reason why they will not come into general use, and I believe that the day is close at hand when the horse will be used only for country purposes.

Modern houses in cities will be designed with a horseless carriage room in the house, so that people will step from the sitting-room to the carriage, pull the lever, and be off to ride at will, at the cost of one fourth of a cent per mile and no expense when not in use. A great many houses to-day have an archway over the drive, and all that will be necessary is to enclose it for the horseless carriage, as there is no odor, and the usual barn smell will be dispensed with, as well as the barn at the same time, which is a great nuisance in cities. There is no

question but that the place for the horseless carriage is in the larger cities, and as fast as they come into general use, they will be crowded out into the country, which will cause better roads and will practically dispense with the dust, which is to be credited to steel tires and the horse, and also the latter is credited with most of the mud on the buggy. Did you ever stop to think what a grand thing it would be to dispense with the clanking of the horses' hoofs on the city pavements, how much cleaner our streets would be, and that with the rubber tires, a city may become a veritable beehive without the deafening noise of to-day as well as the cracking of the whip, in order to force the poor horse over the pavements?

QUESTIONS.

1. What is the total weight of this carriage?

Ans. 1,000 lbs.

2. What part of this weight is made up of the propelling machinery and the gasoline storage?

Ans. Motor and machinery weighs about 400 lbs. including gasoline.

3. How much gasoline is carried?

Ans. Three gallons of common stove gasoline.

4. What are the chances for an accident in the use of gasoline in connection with the carriage?

Ans. There is no opportunity to explode from the use of gasoline in this carriage, as the supply is below the motor.

5. How many persons does this carriage carry?

Ans. It is arranged to be used as a one- or two-seated, four passenger; the back seat folds in so as to give the appearance of a single carriage when used as a two-passenger carriage.

6. What is the cost of propulsion per mile and per ton?

Ans. The cost to operate is about 3c per hour, or about ¼c per mile, depending on the condition of the roads.

7. How long will the carriage run without filling with gasoline?

Ans. Once filling, it will run for 25 to 50 miles according to the roads, as heavy roads require more power and fuel.

8. What is the attainable speed on country roads?

Ans. From nine to twelve miles per hour, depending on the roads.

9. Can it be used on muddy, sandy, or bad roads? or in hilly country?

Ans. There would be seasons of the year, spring and fall, where it would not be practical for country roads, but on ordinary roads or hills it would work all right.

10. Will it be placed upon the market, and how soon?

Ans. We are now manufacturing the carriages, and will have a large number ready for spring delivery.

11. What will be the probable cost?

Ans. $1,400 is the list, and is cheaper than a horse at that, as it is always ready, and never tires, and requires no care.

12. What is the care required to keep this carriage in running order, meaning lubrication, cleaning, and renewals?

Ans. But a trifle more than an ordinary carriage; there is more to lubricate, but it will not get muddy, as the horse is the cause of the splashing of mud and the kicking up of most the dust.

13. How is the electricity supplied for exploding the charge in the motor cylinder?

Ans. An ordinary battery, similar to those used on door-bells is used to ignite the charge in the cylinder.

14. How is the carriage stopped?

Ans. The carriage is stopped by turning the speeding lever toward the backing point, without any reference to whether the motor is stopped or not.

15. At a speed of twelve miles an hour in what distance can it be stopped upon a level road?

Ans. At a speed of twelve miles an hour, it can be stopped in two or three times its length, as the reverse can be used in addition to the brake.

16. In your opinion, what would be the prospect of collisions on a street in a city where the carriages were numerous?

Ans. There would be less opportunity for a collision in

crowded streets, as the carriage is under perfect control, and not like a horse which might get frightened or shy at some passing object.

17. What would be the danger to foot-passengers crossing the street?

Ans. There would be less danger to foot-passengers, as the horse obstructs the view in front of the driver to a certain extent, besides the driver often depends on the horse to turn out.

THE INSPECTOR AND HIS DUTIES IN CONNECTION WITH THE IMPROVEMENT OF THE SHIP CHANNELS OF THE GREAT LAKES.

HARRY HODGMAN.

The president of this society having requested me to write a short paper on the above subject, I will endeavor to do so, though I must confess that the subject is one little likely to interest the learned members of this organization.

The requirements, until recently, for the selection of inspectors have been few, and many persons of very inferior education have succeeded at times in securing appointments to such positions. While many of these have been successful in their work, others have proved absolute failures, oftentimes causing the government the loss of many times their salary. At present, all applicants who secure appointments must have first passed a civil-service examination. The real qualifications for a successful inspector are: first, a good education, and second, what another writer has termed "good horse sense." The inspector should be a man whom the contractor and his employees will respect, and one who readily makes his decisions, and stands by them firmly. He should have self-confidence and self-reliance, being, as far as possible, independent of his superiors in matters which come strictly within his jurisdiction; for no man will retain the confidence of his employer or the respect of the contractor, who is constantly running to his superior officer with every petty trouble which may arise.

The duties of inspectors in this work of channel improvement consist in classifying and estimating the amount of materials removed or placed, and at times, in superintending the work. He is required to observe and record the water-gauge readings, showing the rise and fall of the water at different times during the day, and to make weekly and monthly reports to the engineer officer in charge, showing what has been accomplished during these intervals. As the most of the

work is done with dredges, I will confine this paper to a description of the duties of inspectors of dredging alone.

The government in letting contracts for dredging, usually does so in one of four ways, depending upon the character of the work to be done; namely, first, by the cubic yard in place of, as it is called, by "bank measurement;" second, by the cubic yard measured in the dump scows, called "scow measurement;" third, by weight; fourth, by the hour for furnishing the necessary plant for doing the work, commonly called "hour work."

The bank-measurement scheme is usually employed upon rock work, and where deep cuts are to be made at places where accurate estimates can be made of the amount of materials to be removed. Inspection on this class of work is very simple, the inspector having no particular responsibility except to see that all excavated material is dumped in the proper place. He is required to keep a record of the time worked and the amount of material removed by the dredge. This material is measured in the scows for the purpose of monthly estimates only; the final payments are made at the completion of the work, and are for the estimated amount of material to be removed from the cut as measured in place.

Scow measurement is used where it is inconvenient or impossible to obtain sufficient information for estimating the material in place, and in localities where the nature of the material to be removed is such that it will fill in from the sides of the cuts, thus causing an uncertainty as to the amount it will be necessary to remove. On contracts of this kind inspection is especially trying and difficult, the contractor being ever ready to take advantage of the inspector if he shows the least disposition to be lenient or to be easily bulldozed. The inspector's duty on this class of work is to estimate accurately the amount of material in each scow when loaded, to watch the water-gauge closely, to confine the dredging to the required depth, and from soundings taken by him during the progress of the work, to estimate and deduct any excessive excavation. The tendency of the contractor on this class of work is to beat the

government both on measurement and by excavating too deep, as the deeper the bank, the more cheaply he can remove it.

On contracts where payments are made for the removal of material by weight (usually by the ton), the inspector's duties are much the same as on scow measurement work, except that he estimates the weight instead of the volume of the material removed. This is done by measuring the displacement of the scows before and after dumping each load. Contracts under this system are let where the work is of such an expensive nature that extreme accuracy in measurement is necessary.

Where work is done by the hour, the inspector has complete charge of the plant, and it is his duty to keep a record of the time worked and to secure the best service possible. Much depends upon the inspector, as it is altogether a matter of his management whether the plant is used to the best advantage and also whether it is worked to its full capacity.

A dredge inspector has not an easy job, as the work requires his constant attention. He has a great deal of sounding to do, and is necessarily in the smoke and grease from morning till night in all kinds of weather. However, all work has its pleasant, as well as its disagreeable, phases; and the inspector cannot but find it pleasant to be so situated as to receive the benefits of the bracing water breezes, to view the beautiful scenery encircling our Great Lakes and their connecting rivers, and to become impressed with the greatness of our country by the numberless vessels whose majestic forms are constantly passing to and fro in close proximity to him, carrying in their holds the products of millions of acres of land and of the great mines and manufactories of our country.

THE PROPELLER-WHEEL.

H. C. PEARSONS.

In view of the fact that the propeller-wheel has become a factor of the first importance in carrying on the commerce of the lakes,— and indeed of the world,— and of the further fact that some of the principles on which its usefulness depends are not so generally understood as they should be, saying nothing of some erroneous notions entertained concerning it, I offer the following by way of promoting a more general understanding of it, introducing some new ideas, and correcting some old ones.

While some portions of the subject are necessarily somewhat mathematical, I hope to treat them in a manner so elementary as to make them readily apprehended by the general reader.

THE HOLDING POWER.

1. This constitutes the value of the wheel. It consists of the inertia developed by the action of the blade upon the water. It is measured by the *disk area* of the wheel, by the *draft of the wheel*, or weight of water acted upon, and by the *velocity* of blade in its rotary motion.

2. The disk area varies as the square of the diameter; and when the wheel runs "awash," *i. e.*, with its upper limb at the surface of the water, the weight per unit of the area varies as the depth, whence the total weight of water acted upon by the wheel varies as the cube, or *third power* of the diameter.

3. From the above, we see that the holding power is variable in wheels of different diameters, for the same unit of area. Thus, any unit of area in a 12-foot wheel has twice the holding power of the same unit in a 6-foot wheel, for the reason that it is under twice the weight of water.

4. It is a recognized principle in dynamics that the intensity of the percussion, or action of the blade upon the water, varies as the square of the velocity.

5. While the angular velocity is the same for all points in the diameter, the *linear velocity* varies as the distance from the center of motion. Whence,—

6. The intensity of percussion, for any angular motion, varies as the square of the distance of the point under consideration from the center of motion, or as the square of the radius, or length of blade of wheel.

7. Then, multiplying the weight of water acted upon, which varies as the *third power* of the diameter, by the intensity of the percussion, which varies as the *square* of the diameter, we have a product which is proportional to the total work done by one revolution of the wheel, and which we will call unity for that particular wheel; that is to say,—

For any angular velocity, the inertia developed will vary as the *fifth power* of the diameter of the wheel.

8. Whence, to find the point in the diameter of the wheel, up to which one half of the total work of the wheel is done, we have merely to —

Take the fifth root of $\frac{1}{2}$ *or* .5 = .87% of radius. This point in the length of the blade is called the —

Center of effort of wheel; or center of percussion. But there are other factors to be considered that will throw this center still farther out; viz., the vacant or blank part of the wheel caused by the shaft, the hub, and greatest of all, by the break in the water caused by the thickness of blade near the hub; and as this last-mentioned element is beyond the reach of any correct measurement, we can come at it only by the rule of *guess*,—a method not always to be ignored.

Considering the very small per cent. of the total work of the wheel that is done by the inner part of the length of the blade, it is quite safe to estimate this neutral area at 10% of the disk area. Whence,—

The desired center of effort will be found at a point in the radius, or length of blade, outward from center equal to —

$$\sqrt{.6} = 90\% \text{ of radius.}$$

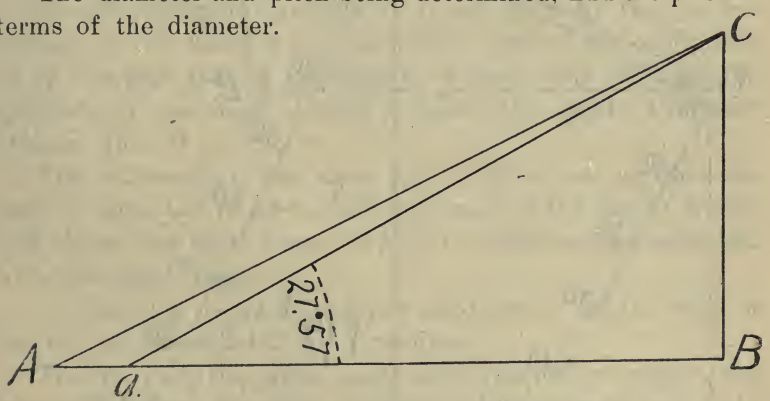
9. *The pitch angle* at this center of effort, is called the *working pitch angle*, and is of the first importance in discussing the propeller-wheel.

It is this angle that determines the relative efficiency of different wheels, having different ratios of diameter to pitch,—a problem that has not, so far as I know, been solved before, without the labor and expense of observing the performance of the wheel in the vessel,—a laborious and tedious process,—whereas, by a method presently to be given, the *relative efficiency* may be determined as soon as the ratio of diameter to pitch is determined, and the *net or absolute efficiency* may be found as soon as the "slip" can be measured.

By this means we avoid the consideration of all those factors, as, *wet surface friction*, *stream line resistance*, *wake resistance*, *block resistance*, and *blade friction*, that must be considered in fixing the power of engine.

10. *Problem: To find the pitch angle, at center of effort.*

The diameter and pitch being determined, find the pitch in terms of the diameter.



From any convenient scale, set off 3.14 units for the circumference, as AB, of a circle of diameter unity.

Set up BC, equal to the ratio of diameter to pitch; say in this case $1\frac{1}{2}$, and make Aa equal to one tenth of AB. Join AC and aC.

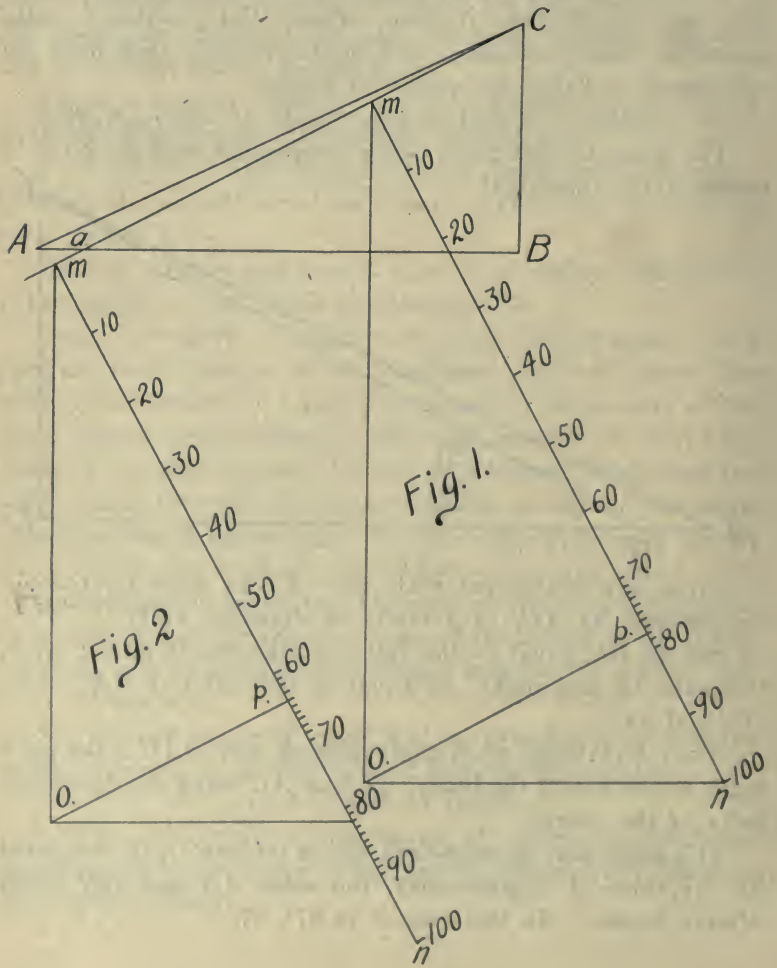
Then BaC is the pitch angle desired, and BAC is the pitch angle at the end of the blade, the line AC being the developed helix of the screw.

This angle may be measured with a protractor, or computed by the rules of trigonometry, the sides AB and BC being always known. In this case it is 27° 57′.

A PRACTICAL EXAMPLE.

11. An example showing the utility and accuracy of this method of finding the efficiency of the propeller-wheel is seen in the trial trip of the steamer "City of Lowell," as reported by Prof. Jas. E. Denton, of Stevens's Institute, Hoboken, N. J., in *Engineering News* for Nov. 14, 1895.

The two wheels of the vessel are 11.1 feet in diameter, each, with a pitch of 16.63 feet, giving one and one-half diameters for the pitch. (See accompanying Fig.)



Having constructed the triangle ABC, as directed in the preceding article,—

Set down from any point on aC, the perpendicular mn, and on it set off 100 units to any convenient scale, to represent the total work delivered to the wheel by the engine, after all expense for friction of machinery, cost of working air-pumps, bilge-pumps, and condensers, are deducted.

Through m draw mo perpendicular to AB, and through o draw on parallel to AB. Then in the triangle mon, which is similar to aBC, the lines om and on may represent two component forces whose resultant is mn,— the total work delivered to the wheel.

The line mo, being parallel to the shaft, would represent the useful part of the work, while no, being perpendicular to the shaft, would represent the lost work.

12. Projecting the point o on to mn at p by the perpendicular op, we have in mp the useful part of the work, and in np the part that is non-useful, or lost; thus we have the *efficiency of the wheel*,— in this case, 78%, while Professor Denton finds it 78.3%.

This efficiency is the same for all wheels having the same ratio of diameter to pitch, without regard to the size of wheel, and shows the limit beyond which no useful work can be had with that pitch angle.

13. But it is desirable to know what part of all the work of the engine is available for propulsion.

To this end, the work spent with friction of engine, the journal bearings, air-pump, condenser, bilge-pumps, and other items about the internal economy of the ship, must be measured or computed and deducted from the total work, and the balance treated as indicated above.

Mr. Denton found the work expended on board ship was 18.3% for items above enumerated, thus giving 81.7% to the wheel. Treating this balance in Fig. 2, as the whole was treated in Fig. 1, we find the efficiency to be 64%. Professor Denton finds it 64%, and we find by trigonometry, 63.73% as the efficiency.

For want of a better name, and not knowing whether this method of finding the relation of the useful to the non-useful work of a wheel has been employed, we will call this the—

Relative or nominal efficiency of wheel; for it must yet be modified by the relation of size to the amount of power to be worked off by the engine.

14. This result is also found by trigonometry as above indicated. It will be seen that in Figs. 1 and 2, the sides *mo*, representing the useful part of the work, are the cosine of the working pitch angle, and that *mp*, in each of the two triangles *mop*, is the square of this cosine, the total power being unity. Whence,—

Cosine square of the pitch angle measures the useful work, while *sine square* measures the lost work.

Following is a table of the nominal efficiency of wheels of different ratios of diameter to pitch, with the pitch angle at center of effort.

This nominal efficiency is that which would prevail if the screw worked as in a solid, without slip, and is the utmost that can be had with that pitch angle.

TABLE OF EFFICIENCIES.

Pitch in Diameters.	Angle of Pitch.	Useful Work, or Cosine^2.	Lost Work, or Sine^2.
1	19° 29′	.889	.111
1¼	23 50	.836	.164
1½	27 57	.780	.220
1¾	31 45	.723	.277
2	35 17	.666	.334

15. If the wheel is large enough to afford the requisite inertia for the engine to work upon, we find but a moderate slip, say 4% to 6% or 8%.

Mr. Denton did not report the slip for the "Lowell," but I find it to be 7.4%, giving a complement of 92.6%. Then multiplying this complement by the nominal efficiency .78%, and by the per cent. of the power delivered to the wheel, we

have the *net efficiency*, which equals $.817 \times .926 \times .78 = 59\%$ of the total work of engine.

Professor Rankine reports the average efficiency of the wheels of his time to run from 55% to 65%, assuming $61\frac{1}{2}\%$ as a good average.

16. But the question comes up, How are we to know the plan of finding how large the wheels must be, to be large enough. It is easy to tell when the wheel is too small. If we find large slip, say 10% to 20% or 25%, or if we see a strong current running off from ship, or a great swell of a sea, or a wave following under her stern, *then we may know the wheel is too small.* It does not afford a sufficient amount of inertia for the engine to work upon, and the unbalanced work of the engine is spent in driving the water astern instead of driving ship ahead.

17. Observation shows us that our most efficient vessels have about one cylindric foot per I. H. P. This, it will be remembered, involves the third power of the diameter, so that the cube root of the I. H. P. would be the diameter, if the top or upper limb of wheel runs near the surface of the water, or if the draft of wheel is greater than the diameter. Then the I. H. P. divided by the draft, and the square root of the quotient will be the diameter required.

The "Lowell's" wheels will illustrate. The diameter of wheels is 11.1 feet; the draft is 12.4 feet. I. H. P. for ordinary daily duty is 3,000, or 1,500 per wheel; then —

$$(1500 \div 12.4)^{\frac{1}{2}} = 11 \text{ feet for diameter,}$$

i. e., this vessel has the inertia of slightly more than one cylindric foot for engine to work upon, when on her ordinary daily service; but on her trial trip, working up to 4,350 I. H. P. or to 2,175 I. H. P. per wheel, the case is different; then we have —

$$(11.1^2 \times 12.4) \div 2175 = .702+,$$

or but 70% of one cylindric foot per I. H. P.

18. This is a most instructive example, due to the carefully prepared report of Professor Denton. From it we find the slip in the first case, *i. e.*, in her daily work, is 4.6%, while in

the second case it is 7.4%, showing an increase of 61% in the ship, for an increase of 69% of the load laid on the wheel, notwithstanding the advantage due to the increased piston speed. The wheel, to afford one cylindric foot, for say 2,000 I. H. P., must be the cube root of power $= 2{,}000^{\frac{1}{3}} = 12.6$ feet.

As good as was the performance of the vessel, it would, without doubt, have made a better showing with a wheel of say 12 ft. diameter, and with a pitch of say 16 ft. instead of 16.63 ft., giving a ratio of $1\frac{1}{3}$ for that of diameter to pitch, and a pitch angle at center of effort, of 25° 14′, and nominal efficiency of .818.

Such a wheel would have held the vessel up to within about 3% or 4% of the pitch, thus giving say 96% efficiency due to disk area; then the 81.8% due to pitch angle, and 81.7% of the total power of the engine, given to the wheel, all multiplied together, will be the net efficiency of the wheel; thus: $.96 \times .818 \times .817 = .6416$, or say 64% instead of the 59%, as shown in Art. 15. From the above we see the importance of disk area.

19. *Blade area* is deemed, by some engineers, to be of great value. But such an idea is a sorry mistake. No amount of the width of the blade can compensate for even a small fraction of the length.

This is seen in the performance of steamers that, by accident, have lost one blade, and by necessity have lost another one opposite, to preserve the balance. Such vessels make their schedule time with the same regularity as before the accident.

Do not spend time with blade area to make up for deficient disk area; it is only so much lost effort.

20. *Ultimate limit of Efficiency.*—This, as we have seen, depends on three conditions: the amount, or per cent., of the total work of engine delivered to wheel; the pitch angle at center of effort; and the slip, or rather the complement of slip. And the study of the engineer is to know when they are at the greatest.

With our multicylinder engines, probably 15% is as small a per cent. of the total work as will suffice to set the machinery in motion and overcome the friction of the loaded engine, thus giving 85% to the wheel.

The pitch angle at center of effort, we have seen (Art. 10), depends on the ratio of diameter to pitch; and that the cosine of this angle, or rather the cosine squared, is the measure of the useful work available with that pitch angle, also that this cosine is greater, as the angle is less. But Professor Perry in his "Notes on Steam," page 340, tells us that "*the efficiency is increased by increasing the pitch.*" Such fallacies and mistakes as this by highly educated men, spread far and wide with most engineers,—thus keeping facts out of sight.

The slip, we have seen (Art. 18), may be as small as 4% or 5%, giving an efficiency due to disk area of say 95%.

But this factor is also a stumbling-block for too many of our engineers. One says "*his wheels run too near to the pitch :*" in other words, he would call them better if they gave more slip. Another says a wheel is doing nothing if it does not show a liberal slip; as much as to say that a good, healthy, full-grown slip in a wheel is a sign of merit. Another is glad to see a strong stream running off from the vessel, forgetting that the "moment" of this stream is so much taken from that of the vessel, by lack of disk area in the wheel.

From the preceding table, we see that those wheels, having about 1 to 1⅛ diameters for the pitch, are most efficient, say 1¼, giving an efficiency, nominal, of 85%.

These three factors, viz., per cent. given to wheel, per cent. due to pitch angle, and per cent. due to disk area, or the complement of slip, constitute a compound fraction; thus, $.85 \times .85 \times .95 = .686$ or 68.6% = *ultimate efficiency*, beyond which we cannot hope to go.

21. To find our minimum limit: we will probably find some of our vessels giving as little as 80% of their total engine work to the wheel. And we will not infrequently find a wheel of 1½ to 1¾ diameters for the pitch, say 1⅝ diameter, giving a nominal efficiency of 75%. And we find some engineers for

whom a slip of 15%, 20%, or even 25% has no terrors, say 20%, giving an efficiency of 80% due to disk area; then, $.80 \times .75 \times .80 = .48$, or 48% as our *minimum limit of efficiency.*

22. *Negative Slip.*—This is a misnomer; there is no such thing as negative slip, notwithstanding the many laughable and lamentably absurd theories that have been given, even by educated men, to explain the seeming paradox.

What appears to be such, is the result of incorrect measurement of the pitch, on those wheels that seem to have a negative slip.

It is only with those wheels that have what is called an axially expanding pitch, that such results are seen. In such wheels, the mean of the pitch at the leading edge, and of that at the trailing edge, is taken as the pitch of the wheel. This gives us the pitch at the middle of the width of the blade; but this is not the correct pitch of the wheel.

The fundamental idea is to make the pitch at the leading edge of the blade, equal, as nearly as may be estimated, to the "net pitch," *i. e.*, to the pitch made by one turn of the screw, not the pitch of the wheel, but the actual advance of slip for one turn of wheel. In this case the work at the forward edge of the blade would be zero.

Then by making the after face, *i. e.*, the working face of the blade, concave, like the arc of a circle, the intensity of work is gradually increased from the leading to the trailing edge, so that the entire work of the blade may be represented by a triangle, with the apex forward.

But we all know that the center of moment, or gravity, of a triangle, is at $\frac{1}{3}$ the height above the base. Whence, the tangent that represents the direction of the helix, or motion of any point in the end of the blade, in its revolution, should be drawn to the curve, at $\frac{1}{3}$ the distance from after edge of the blade forward, and not at $\frac{1}{2}$ the distance. The direction of the helix or pitch line being found at this point, we will never hear of the negative slip.

23. But such wheels are always wasteful agents in the use of power, without any redeeming feature to compensate the loss.

If for want of skill in the design, the pitch of the forward edge of the blade is made less than that of the "net pitch," then the forward edge of the blade takes water on the forward face, or on what is called the back of the blade, and thereby does negative work; *i. e.*, it takes power from that which would otherwise be used in useful work, and turns it against us, thus making a double loss.

And if the screw fully meets the design, then the work at forward edge is nothing, thus throwing the principal part of the work to the after part of the blade, where the angle of pitch is greater, and where, consequently, the loss of work from oblique action of the blade is greater, thus showing to a disadvantage in either case.

With the high steam tension and the high piston speed that our marine engineers have so profitably developed during the last few years, and with the prospect of further successes in store for them, the *true screw* is the only wheel worth their consideration.

A CASE IN LAND SURVEYING.

F. HODGMAN.

The questions of practise in land surveying have been so thoroughly discussed in this society, and set forth in the legal decisions which have been published in our Annual from time to time, that it would seem as if there were little left in that line to present. Once in a while, however, a new question comes up. Such a question was brought to my attention last fall by a gentleman from northern Wisconsin, who asked my advice. It is an old question with a variation which brings out a point that I have not seen passed upon by the courts or the general land office.

The case is this: Section 18 of a certain township in northern Wisconsin is anomalous, being 148 chains and some links long east and west. Hence, in the north and south boundaries of the section, quarter section corners were planted in the U. S. survey at 48, 80, and 120 chains from the east line. This would cut no figure in the case were it not for the fact that these quarter corners in the north line of the section are not in a straight line. One of them is said to be 7 chains too far north. The northeast corner of the section and the east quarter post are in a lake. The 40-chain post on the north line of the section is, if I remember rightly, also in the lake. The question is, How shall the east and the west quarter line of the section be located? One party claims that it should run east from the west quarter post to the lake on a course intermediate between those of the section lines. This would cause it to bend to the north to correspond with the crooked north line. My advice was as follows: —

CLIMAX, MICH., Nov. 24, 1897.

Mr. J. R. Farr,
Phillips, Wis.

DEAR SIR: What I understand that you wish is my opinion as to the proper manner of determining the location of the east and west quarter line through sections 17 and 18, T 37 N, R 1 E, Wisconsin.

In my judgment, the first thing to do is to locate as many as possible of the corners which were marked on the U. S. survey of these sections, and so many of those on the adjoining sections, as may be necessary to assist in relocating the missing ones. In this connection I call attention to my "Manual of Land Surveying," pages 296–303, and also to matter on the same subject in the "Proceedings of the Michigan Engineering Society," for 1885, pages 17 – 20, a copy of which I send you herewith.

I will assume that this work has been thoroughly done, and that none of the original corners marked *O* on your sketch can be found. The next step is to relocate the corner of sections 7, 8, 17, and 18 in the lake. If practicable, this may be done on the ice, which is especially desirable to do in case the original surveys were made upon the ice as you will thereby approximate more nearly to the conditions under which the corners were originally located. This corner should be located at its proportional distance from the nearest identified government corners, north, south, east, and west, from it as shown by the field notes of the United States survey thereof, and, according to the principles laid down in the case of Moreland *vs.* Page, 2nd Clarkes, Iowa 139. This case is fully illustrated and discussed in the report, and I think it is everywhere accepted as sound law. Having located the corner of 7, 8, 17, and 18, next locate the ¼ section corner between sections 17 and 18 in line with, and at its proportional distance between, the Meander Post on the south bank of the lake and the corner of sections 7, 8, 17, and 18. (See Jones *vs.* Kimble, 19 Wisconsin, page 429.) This ¼ section corner is the vital point of the whole work, for it determines the location of the east and west quarter lines in both sections 17 and 18. Having located it, run lines straight from it to the corresponding quarter-section corners on the opposite sides of sections 17 and 18. (See "Manual of Land Surveying," page 182, Second.)

I have marked upon your sketch the distances by the accompanying field notes from the section corner and quarter post to the nearest identified government corners each way, with which these corners should be located to correspond, and have also marked the location of the east and west quarter lines.

In connection with the procedure recommended for locating the corners in the lake, which I understand to be merely corners obliterated by the melting of the ice after it was marked, I would call attention to the circular on restoration of lost and obliterated corners issued by the General Land Office, Oct. 16, 1896, pages 9 and 10. If you have not this circular, you can get it by applying to the Land Office at Washington. I also send you a pamphlet containing a paper on the use of proportional measures.

Respectfully yours,

F. Hodgman.

Why the above advice? — One reason is because no other method will produce harmonious lines on section 18 and section 17 on the opposite side of the lake, and this method will.

The corners on the section line should be common to the adjoining sections 17 and 18, and this makes them so. Any other method would result in double sets of corners, where no such corners were intended. The statute says that the boundary lines of sections and subdivisions "which have not been actually run and marked shall be ascertained by running straight lines from the established corners to the opposite corresponding corners; but in those portions of the fractional townships where *no such* opposite corresponding corners have been *or can be fixed*, the boundary lines shall be ascertained by running from the established corners due north and south, or east and west lines, as the case may be," etc. What is the object in using those words, "*or can be fixed*"?—It seems to me that the only object is to exclude from the rule all those cases where corners have not been, but *can be* fixed. The inference is plain that if such missing corners can be fixed, it should be done, and the boundary lines located in accordance with them. Here comes a point upon which I can find no official ruling either from the courts or the general land office. Is a case where it is practicable at a certain season of the year to locate the missing corners, as, for instance, on the ice in winter or on the land when the waters have receded in dry seasons, to be treated the same as a case where they cannot be fixed? In my view of the case, it cannot be legally done. It is neither good common sense nor good law. If it be possible at certain times in the year to locate the missing corners, that fact excludes the case from the operation of the law which in certain cases requires the boundary lines to be run due north and south or east and west. I believe this to be specially true of all cases like this, where the lake takes up only a comparatively small portion of the section, and there is an opposite corresponding section to be considered. In such cases, I would go further, and say that even if it were impracticable to run the lines on the ice, they should still be run to strike the same points that they would if the lines could be run and the corners located on the ice.

In this Wisconsin case there is still another element to be considered. The United States survey was made in April. The climate of northern Wisconsin is such as to render it very probable, in fact almost certain, that the survey was made upon the ice. If so, the missing corners must have had their location determined and marked on the ice, even though no permanent landmarks were or could be planted there. The probability that such was the case is rendered a moral certainty by the fact that a resurvey made in November last on the ice tallied almost exactly with the field notes of the U. S. survey. Now can a case where the original survey was made on the ice, and the positions of the corners actually located, and where, in ordinary seasons, they may be relocated at any time from November to April inclusive,— can such a case be treated legally as one where no such corners have been or can be fixed? — My judgment is most emphatically no. This case is in the Wisconsin courts, and if they do not decide it on some side issue, like possession or agreement of parties, we shall probably find out in the course of time what their views are on the point in question.

MATERIALS FOR STREET PAVING.

To the Michigan Engineering Society.

GENTLEMEN: Your Committee on Materials for Street Paving herewith present the following regarding the materials used in the cities of Michigan: —

Wood (cedar), because of its cheapness, is the most extensively used of any material, and for that reason, will continue to be used for years to come.

Vitrified brick holds second place in the amount used, and first place as to being the proper material to use, judging from the answers to letters sent to all the principal cities of the State.

Asphalt pavement is only slightly behind brick in the amount in use in this State; and another year may, should present prices continue, see it in the lead.

Macadam is used in but few places, because of the scarcity of suitable material.

Hard limestone, broken and rolled, makes a good road for light traffic. For heavier traffic, the surface should be covered with hard field stones crushed, while for streets very much traveled, a more substantial pavement is required.

For country roads and residence streets of light traffic, gravel of good quality can be used to make a road that will be very satisfactory. All sand should be screened out, and the gravel passed through a crusher to bring it to a nearly uniform size. Spread about four inches deep, on a well-rolled roadbed and roll well, using a small amount of gravelly clay, or hard pan, for binding.

About three layers as above described, with plenty of rolling with a ten-ton steam roller, will make a good road, very pleasant to drive upon, and free from the objectionable dust so common to limestone macadam streets.

Such gravel streets occupy a position, in point of durability, between the limestone macadam and the macadam composed

of our tough field stone, and where the gravel can be conveniently obtained, the cost is less than the cheapest macadam.

To return again to our pavements proper, and to show the relative amounts of the different kinds of pavements in use, there are enough cedar blocks in the streets of Detroit alone, to pave a roadway 30 feet wide and 183.6 miles long. This amount is probably less than half the amount in the State.

In nine cities reporting brick pavements, we find enough to pave a 30-foot roadway for 37.1 miles. The total amount in the State is probably less than 50 miles.

It is believed that only three cities in Michigan have put down asphalt pavements; namely, Detroit, Grand Rapids, and Saginaw. The amount laid would pave a 30-foot roadway 32.2 miles long, an amount less than one sixth of that laid in Buffalo, N. Y., alone.

It is gratifying to note that in the nine cities reporting brick pavements, only three use anything but a concrete foundation, and that, with two exceptions, not less than six inches thick, the proportions being, usually, 1 part cement, 2 parts sand, and four parts broken stone. Only one city reported using a course of brick laid flat for a foundation; another used broken stone rolled, and one (Kalamazoo) has some on concrete and some on broken stone. Grand Rapids and Lansing have brick laid on four inches of concrete.

For cedar block pavement the most common foundation is boards laid lengthwise of the street, upon a sand foundation. The boards are then covered with sand and the cedar placed thereon, the interstices filled with gravel, well tamped, and the whole surface then tamped or rolled, after which a coat of coarse sand or fine gravel is spread over the top, and the street opened for traffic. Detroit, Grand Rapids, and Saginaw, have laid cedar blocks on concrete foundation; and the first two cities have filled the joints with hot pitch. The block pavements thus treated in Grand Rapids six years ago are badly decayed, and appear no better than pavements in which the joints are filled with gravel only. The advisability of putting a concrete foundation under cedar blocks is questioned, as it is

claimed the blocks decay faster than when put on boards or gravel. Saginaw and Grand Rapids have put down cedar blocks five inches in depth, so that they could be replaced with brick, by adding one inch more of cushion.

The cost of cedar block pavement varies with the location. Detroit reports, $1 per sq. yd., and Grand Rapids $1.10 per sq. yd., joints filled with pitch in both cities; Saginaw 72 cts. per sq. yd., joints filled with gravel. The pitch would add about 20 cts. per yd., making the cost at Saginaw 92 cts. All are on concrete six inches thick. On 1-inch pine boards the cost at Port Huron is given at 55 cts. In Manistee, on 1- and 2-inch hemlock planks, the cost is 57 cts. per sq. yd.

Owing to free competition, the reduction in the cost of cedar block and brick pavements has been uniform with the reduction in wages paid to labor; but not until recently has the price of asphalt pavement been much reduced. Until within a few years, only the Trinidad Lake Asphalt and the European Rock Asphalt were considered suitable for pavements. The former material was controlled by the Barber Asphalt Paving Co. and the Warren-Scharf Asphalt Paving Co. Within a few years asphalt from California, Utah, and Venezuela, and rock asphalt from Kentucky and Indian Territory, have been placed on the market. The construction of comparatively cheap portable plants has enabled companies of small capital to embark in the asphalt paving business, thus securing competition and a corresponding reduction in prices.

The first asphalt pavement laid in Grand Rapids, in 1890, cost $2.90 per sq. yd. Concrete 6 inches thick, ½-inch cushion, and 2-inch top. During the past season, asphalt pavements were built, using 6-inch concrete, 1-inch binder, and 2-inch top, for $1.65 per yd.

Detroit reports the current price of asphalt on 6 inches concrete, ½-inch cushion, and 2-inch top, at $2.25 per yd., and Saginaw for 6 inches concrete, 1-inch binder, and 1½-inch top, $1.53 per. yd.

Detroit reports the price of brick on 6-inch concrete foundation at $1.60 per sq. yd.; Grand Rapids, $1.50; Saginaw, $1.27;

and Jackson, $1.24; — all with coal tar filler (Portland cement filler in Saginaw).

For a full report on street paving you are referred to the report of the Committee on Paving of the American Society of Municipal Improvements, presented at the annual convention held October last, at Nashville, Tenn. The above-mentioned committee collected statistics from all over the United States, and was able to make a valuable report.

In the technical journals have appeared during the year numerous articles regarding asphalt and asphalt pavements, and the testing of paving materials. No attempt has been made to review these articles, for the reason that they should be read in full by those making a study of the subject.

For a very complete discussion of the paving problems as presented to all our smaller cities, your attention is called to a little book by William Pierson Judson, entitled "City Roads and Pavements suited to Oswego, N. Y.," R. J. Oliphant, printer and bookbinder, Oswego, N. Y.

Respectfully submitted,

GEO. M. AMES,
E. W. MUENSCHER,
Committee.

PROFESSOR DAVIS: The success of pavement in any large city is so largely a matter of climate and usage that it seems to me the only test we want to know about is the test of actual wear and tear. A city beginning to improve its streets should begin to use pavements of different kinds in a moderate manner and let their experience tell them what they will do. Mr. Ames has not said anything about granite block pavement which must be used on streets where there is the heaviest traffic. How asphalt will act under certain conditions must be determined by actual experience.

MR. RIGGS: In the past 60 days I have been in a number of cities in Ohio, some 15 or 20 of the smaller cities, where brick pavements are used, and I find the experience in most of them is the same as we had in Toledo, and in most Michigan cities;

that is, they wear out on account of the non-uniformity of the brick. I have seen brick pavements laid with hard brick, soft brick, and medium brick. The inspector ought to be impressed with the necessity of getting uniform brick in order to have a satisfactory pavement.

Mr. Hodgman: Would n't uniformly soft brick be as good or better than part soft and part hard?

Mr. Riggs: It would be better.

Professor Davis: There is no question about it. I think this brick question is just exactly in the same position that the cement question was ten years ago. The brick has got to be perfected by the manufacturer, just as the cement manufacturer has perfected his product until we can get a uniform cement at the present time. It must be done in the mixing before the burning. I believe the burning process at the present time is well enough understood.

Mr. Wells: Would you put an inspector at the works?

Professor Davis: No, I don't believe in that. Some 25 years ago the engineers of the country experimented faithfully in endeavoring to inspect iron from the ore-bed to the bridge, or whatever they were building, and it proved to be a failure. At that time there was a great and a just outcry on the part of the manufacturer. Engineers who did n't know anything about these things presumed to decide them for the manufacturer. The engineer, as I conceive it, and believe, was out of his place. I don't believe in meddling with the manufacturer in that kind of way. I believe that it is a good thing for each of us to find out that there are other people in the world, just as good and just as honest as we are.

President: In regard to the life of cedar block pavement, upon different soil, we have some interesting illustrations. We have two streets laid in '90, one on the south side of the river, entirely on clay, with a pretty good traffic all the time, on one of the main roads entering the city, has a pretty good farmers' traffic; another laid the same year upon the north side is in dry sand, ten or twelve feet deep before you reach the clay. If you go on to the street laid on sand and take out a block,

you could n't pick up enough pieces to put it back again, and the other is in pretty good shape.

PROFESSOR DAVIS: The blocks on the sand street are alternately wet and dry, which is a destructive thing; the blocks on the heavy clay are wet as much as the other, but are not dry nearly so often.

PRESIDENT: It is customary to specify sand foundation on clay below the blocks, how much would it be advisable to use? If sand is destructive, we don't want any more of it than we need. Our specifications call for four inches. They used to call for six.

MR. SEARS: I think you would get better results if you put two inches of clay on top of the sand.

PRESIDENT: It is difficult to lay the clay evenly.

PROFESSOR DAVIS: Some day some of us smart young fellows, just starting out in the world, will construct a clay pulverizer.

PRESIDENT: I understand that cedar blocks laid on concrete foundation fail rapidly. I would like to know if any members of the society have had any opportunity to observe.

COLONEL MUENSCHER: Our experience has been that the streets which are kept wet keep a good deal longer. We have block pavements which are not wet at all, and which don't last over five or six years before they are ready to go to pieces; others watered every day last ten or twelve years.

MR. RIGGS: I only know one pavement in our city laid on concrete, a street that has a good deal of traffic on it. The pavement has been there four or five years, and is in good condition to-day. I think it has been in five years, and it is one of the best pavements of the city to-day. It is fully as good as some brick pavements made at the same time.

PRESIDENT: I am told the rot starts at the bottom.

MR. SEARS: Why could n't you lay it in coal tar at the bottom?

PRESIDENT: According to this report, it is of no use.

PROFESSOR DAVIS: It is a damage.

PRESIDENT: We have a concrete foundation put in two

years ago, and it was so hard that when we had to tear a small piece up, it was almost impossible to pick it out with crowbars.

Mr. Wells: You have heard the story of the old lady who said that there was no great loss without some small gain, when the house burned up, she saved the ashes to make soap. Most of you know that our factory burned down a year ago this month. They lost considerable; but I learned something. Our people had salt blocks in connection with their works. The foundation timbers had been in use for forty years. We mined — you might say — the sills of the old salt block, that didn't burn, for timbers for the new mills. They had been exposed to the weather for forty years, just between wind and water, where timber generally decays. And the preservative effects the salt had upon them were wonderful. I wonder if, in place of these concrete foundations for cedar block pavement, if it was made tight, so that the dissolved salt wouldn't get away, and a good contact made between the concrete and the curb, and a moderate amount of salt sprinkled there, you wouldn't do away with these bad results. I would put salt and sand together.

Professor Davis: I was brought up on the coast of Massachusetts, where there were acres and acres of salt manufactured by the solar process. The posts in use were thoroughly saturated with salt, and I don't think there is a man living who ever saw one of them rot. Those posts are handed down from one generation to another.

Mr. Smith: What action would the salt liquor have upon the concrete?

Professor Davis: I don't think it would hurt it. We sometimes use salt to mix with mortar, you know, in the winter time, to prevent freezing. I think it is worth trying.

Colonel Muenscher: I took up some pavement this year that was laid twelve years ago,— cedar blocks. Many of them were almost as sound as the day they were put in, and others you could crumble up with your hand. You would have to watch the cedar very carefully when it is put down in the

pavement, and even then a man has got to be pretty well acquainted with cedar.

Mr. Sears: I have noticed that it will wear out on the sides, and in spots where it is not used, as quickly as where it is used.

Colonel Muenscher: We have some in our city that is hardly used except in going to one man's establishment. It was laid eight years ago, and is all gone to pieces.

President: What do you consider the average life of cedar block pavement in your city?

Colonel Muenscher: We have just taken up some laid in '84. It had been rough for the last two years, and was becoming worse all the time.

Mr. Sears: I have noticed that there is a great deal of waste and loss in making the paved areas too large.

Professor Davis: I think the width of the roadway should be made in accordance with the character and use of the street. It should be narrow in residence streets, and could be made wider, should the character of the street change.

Mr. Walker: I had some little to do with the pavement business, the first that was ever put down in this city. I did n't pretend to know anything about it; but the parties interested with me were practical men. It was from Military Street up Water Street. The same year that it was put in, Huron Avenue was paved; and the next year this street was paved. That pavement was a comparatively good pavement after this had been worn out and relaid, and relaid the second time. We found on investigating that it was in the class of cedar that was put in. There was no dead cedar in the Water Street pavement, it was all live cedar. About that time there appeared to be a slackness, or very little attention paid to the timber used, not only here but in Detroit and at other places, and anything that was cedar would do for paving; it did n't make any difference if there was a hole four or six inches in diameter inside, if there was a shell outside. I am satisfied that there was cedar laid on the streets here, and considerable of it, that had been dead for ten or twelve years. I think this in regard to cedar

pavement: If you take live cedar, without sap, and lay it properly, you have got a street that will last, one year with another, twice as long as the ordinary way of laying cedar pavements. I think that if a tree lies dead in the woods for five or six years, the best part of that tree is gone. You take that dead tree and put it in the streets and it is simply gone in two or three years more.

Mr. Riggs: There is one question that I want to ask, and that is in relation to filler for brick pavements. Portland cement, on a stone and sand foundation, has been quite generally used in the city of Columbus. The city engineer — and he is a good man, and well posted — says that it is a total failure. The objections which occur to me are that it is noisy, and that the expansion and contraction will probably go a long way toward destroying it. I would like to know something of the experience of the members in the matter of filler.

President: I have had no experience except what we have had here. We have hung to the tar filler. I understand that the cement filler makes a noisy filler. I would not dare to use cement filler unless I put half an inch tar filler at each curb and broke it up into sections, say every 50 feet.

Mr. Riggs: I examined an old pavement where they had used Alpha cement, and the brick were like the teeth in an old man's head,— you could shake them around every way. It was simply a disintegrated mass of brick and mortar.

Professor Davis: I understand the standard filler to be three parts asphalt and one part coal tar. When the street expands from the heat, it gives it a chance to expand without being squeezed. When it is cold, it has still some little elasticity, and the pavement keeps its place, the exact opposite of which is true of cement. There is no provision for the expansion of the street endways; and it is going to make trouble when the contraction takes place the following winter. Something has to break. In the use of a plastic filler, I conceive that you want the bricks clean.

W. L. COFFINBERRY.—A SKETCH.

DORR SKEELS.

THERE is a grandeur of perfection in the system of created things, and a just inference is that man crowns a complete creation.

In the town of Lancaster, county of Fairfield, and State of Ohio, on the fifth day of April, 1807, the subject of this sketch was born, and christened Wright Lewis Coffinberry. He passed successfully the period of "happy boyhood days" where is now the city of Mansfield. When he was five and six years old, the war of 1812 occurred, in which he participated to the extent that he witnessed some skirmishes with the Indians, and heard the cannonading at Put-in-Bay at the celebration of Perry's victory on Lake Erie.

In speaking of his mother, he relates one instance of frontier life. His father had built a new house, and a blanket was hung up for a door. One evening his mother noticed the blanket pushed aside, and a bear passed his fore parts in, took a beef bone from the table, and backed out with it. She, thinking that would pacify him for the night, made no alarm.

Coffinberry's school education was limited to one month's attendance at the district school during each winter of 1826 and 1827. At the age of eighteen he began to learn the trade of millwright, and after serving an apprenticeship of three years, he followed that trade until 1829. At that time all mill machinery, water-wheels, gearing, elevators, etc., were made by hand. In that year Mr. Knapp, the resident engineer, at New Baltimore, of that part of the Ohio canal, knowing of Mr. Coffinberry's mechanical ability, asked him to assist them one day, as the regular assistant was sick. Mr. Coffinberry replied that he was not an engineer, and might not answer the purpose; but being assured he could make and drive stakes, he went with the party. He relates that day's experience as

follows: "On our return from work we passed a contractor cutting stone for a culvert under the canal. The contractor asked Mr. Knapp if he would make him a pattern for the 'ring stone' for the arch. Mr. Knapp replied, 'I have not time now, but can show you how to make one.' While he was demonstrating with a long straight-edge rule, I asked him if he wished the heading joints to fit on the radius of a circle. He replied, 'Certainly.' 'Then I think you are in error.' The remark so offended his dignity that he replied, sneeringly, 'If you know better how to make that pattern than I do, I want you to tell him.' I begged his pardon, took the rule and pencil, and proceeded to show him where the error was. The result was that Mr. Knapp took off his hat, thanked me, begged my pardon, and the next day put me in charge of the laying out and constructing of a lock pit."

From that time up to 1835 he worked at the millwright business and engineering, and procured and studied the best works on engineering. On the 18th day of August, 1831, he married Miss Jane Beach, a very estimable woman, who survived him a few years.

In the winter of 1835 he was engaged with a party from Detroit in surveying the Black Fork, Clear Fork, and Jerome Fork tributaries to the Mohecan and Vernon Rivers. The next year he was engaged with Samuel R. Curtis, since Major-General Curtis, as first assistant, running preliminary lines for railroad and canal work. In 1837 he went on to the Muskingum River Slack-Water Improvement. While on this work a young man sent by Mr. Curtis came to him as rod man. This young man was John Sherman, since senator from Ohio, and now Secretary of State. The friendship there formed was kept up by correspondence and otherwise during Mr. Coffinberry's life.

In 1842 he began learning the trade of watchmaker and jeweler at Mansfield, O., from which place, in 1844, he moved to Centreville, in this State, lived there two years, and then moved to Grand Rapids, where he continued the watchmaking business. He was a fine mechanic, and it would afford him

intense pleasure to get a watch that required some of the works to be made new. The more delicate the mechanism, the greater the enjoyment.

In 1849 he surveyed and located the plank road from Grand Rapids to Kalamazoo. In this year Grand Rapids was organized as a city, and in 1850 Mr. Coffinberry was appointed its first engineer. Four sections of land were included in the incorporation, and after many trials he succeeded in getting an appropriation to furnish and set iron stakes at each government corner, some of which are still in place. As the worthy aldermen could not see the finished work by looking at the profile and map, improvements were slow.

In the early spring of 1851, the mayor of the young city asked him if he would accept a contract to do a job of government surveying in the north part of the State. After considering it in his family, he concluded to accept it. Of this particular time he writes: —

"There are times, I presume, in the lives of all persons when the Fates of this world seem to be turned against them; and so with us, our time for misfortune seemed to have arrived."

Charles Noble was surveyor-general stationed at Detroit, to which place Mr. Coffinberry went to have an examination. This he passed successfully, was complimented on his ability, and was told his contract and instructions would be sent him as soon as he could get ready to go to the woods. Returning to Grand Rapids, he sent his family to their old home in Ohio for the summer, got his camp fixtures, supplies, and surveying party all ready, expecting each day would bring his appointment and instructions. He waited until the middle of summer; and the season being then so far advanced he could accomplish but little if he went to the woods, he gave up and went for his family. On his return he called at the surveyor-general's office, and was there informed that no contracts would be let that year. He passed the remainder of the year in Grand Rapids, working at surveying and watch-repairing. He said: "There was not much work that came my way; but I had

plenty of pork, beans, and hard bread, so got through the winter."

The next spring, 1852, he received a contract for the re-surveying of towns 21 and 22 north, range 6, 7, and 8 west, meridian of Michigan. Having his camp outfit, he made up his party. It took about one week to reach the head of the "Big Rapids" on the Muskegon River, where is now the city of Big Rapids. Here the teams left them. A trapper by the name of John Parrish, a middle-aged man, lived here during the summer season, and followed his occupation during the winter.

As one field of his work was a part of the territory embraced in Mr. Coffinberry's contract, he was engaged by the latter as his packer. They here constructed from a pine-tree a canoe of such dimensions that they could lay four barrels of pork or flour crosswise in the bottom, and started up the river, it being some seventy-five miles by that route to the mouth of the Clam River, a stream running through the land he was to survey, and up which he proposed to canoe his provisions. When they got to the mouth of the Clam, they found that some four or five miles of the lower end was filled so completely with fallen cedar and driftwood that it would be better to go on up the Muskegon some twelve miles farther, at which point the Clam was only about three miles away and nearly free from fallen timber. Here they anchored their canoe and packed the outfit across to the Clam. When nearing their camp, while going over with the last load, they heard the report of a gun. The packer said, "My God, Mr. Coffinberry, that was my gun;" dropped his pack, and started on a run. On arriving at the camp he found the fire had burned everything but the pork, and was burning that. They built a shanty of logs strong enough to secure the pork from the bears and wolves, came back to Grand Rapids, got another outfit, and returned to the work, which was some twelve miles north of this depot. When he got fairly at work, his son Andrew, who had accompanied him, was taken very ill with a fever. He administered such remedies as he had, but the son continued to grow worse.

A consultation was held by the party, and they decided the best thing to do was to take him home. They constructed a litter, placed him on it, carried him to the Muskegon, put him into the canoe, and went down the river to Lake Michigan. Here they transferred to a sailboat which took them to Grand Haven, at which point they boarded a steamboat for Grand Rapids. In the meantime, and since leaving the mouth of the Muskegon, the fever had seemed to abate, and by the time Grand Rapids was reached, the patient was entirely free from any fever.

As Mr. Coffinberry had to have his canoe to bring his party and outfit home in the fall, there was no way but to return to his work over the same course. He reached his camp in the woods without any serious accident, and finished one township that year.

For the foregoing information, I am indebted to Mr. A. B. Coffinberry and his sisters, the Misses Coffinberry, for the use of an unfinished autobiography which their father had begun previous to his death.

My acquaintance with Mr. Coffinberry began in the spring of 1853, when I went with him as ax man to assist in finishing the contract of re-surveying the other five townships, which was accomplished in October of that year. In 1855 he was appointed city engineer of Grand Rapids, which office he held until 1858. In 1859 he surveyed a State road, commencing at the northwest corner of Kent County, thence north through Newaygo and Traverse City to Northport, about 158 miles, and the next year filled a contract for cutting out and bridging forty miles of it north of Newaygo. In 1861 he enlisted for the war, and raised Company C of the First Regiment, Michigan Engineers and Mechanics, and served one year and a half as its captain, after which he resigned and came home. From that time to 1870 he did a general business of surveying and engineering. In 1871 he was appointed city engineer, which was his last term. About Christmas the following year he was stricken with inflammatory rheumatism, that confined him to the house till the middle of the next summer, and from which

he never fully recovered; as it disabled him for active work the remainder of his life.

He was an enthusiast in natural history and a charter member of the Grand Rapids Lyceum for the Study of Natural Science, which later took the name of the Kent Scientific Institute. He was its president many terms, was chairman of its committee on archeology, explored the mounds in the Grand River Valley, excavating many of them, and finding therein a great quantity of relics, pottery, totems, and copper implements. He was a member of the American Association for the Advancement of Science, before which society, at its meeting in Detroit in 1871, he read a paper on "Archeology" and exhibited specimens from the mounds in the vicinity of Grand Rapids. At the meeting of the same society at Buffalo in 1886, he read an illustrated paper on the "Traveling of the Larvæ of the Flesh Fly." That was his last meeting with the society. He was one of the county superintendents of poor, and on March 26, 1889, he boarded a street-car in front of his house to go to his office. As he arose to go out, when the car stopped at its terminal, he fell forward to the opposite seat dead. We had often talked of life, living, and dying, and he often expressed the wish that he might die suddenly, without suffering.

As was fittingly said after his death, "he was a man of action rather than profession. He was a man whose life was made up of deeds which, without seeming great in themselves, yet as a mass, would build a monument. He was simple and unpretentious; but great in the little duties and details of life. A man of strong convictions was he, but yet of the broadest charity."

If he could not help one up the hill, he would block the wheel to prevent him coming down. He believed that man would attain his highest usefulness when he had the largest liberty. He believed in doing right, not through fear of the torture of a hell, or the reward of a heaven, but *because it was right.*

The poet has fittingly said : —

"We come into the world naked and bare ;
Our passage through is trouble and care.
We die and go — no one knows where ;
If we do well here, we will do well there."

After a ripe age, death met him like a gentle sleep — no pain, full of peace. May the memory of his worth never perish !

RECENT LEGAL DECISIONS.

The references in the following legal decisions are to the several law reporters published by the West Publishing Co., St. Paul, Minn.: —

ADVERSE POSSESSION.

1. Before one can be deprived of rights based on the record evidence of title, on the ground of notice from adverse possession, it must appear that such possession was open, notorious, and unequivocal; and no joint and indefinite possession, as that of two corporations, one of which owns all the stock of the other through officers who are officers of both, is sufficient to give notice of the equitable rights of one as against the record title of the other.— National Waterworks Co. of New York v. Kansas City (C. C.), 78 F. 428; Kansas City v. National Waterworks Co. of New York, Id.; Coquard v. Bannard, Id.

2. As a general rule, a deed, to constitute color of title, must actually cover the land claimed under it, regardless of the belief of the parties to it, if there is no mistake as to the descriptive words used.— Williamson v. Tison (Ga.) 26 S. E. 766.

3. A railroad company, in 1853, obtained a deed from an owner of land granting right of way, though neither the land nor right of way was described in the deed. The construction of the road was thereafter suspended, no work having been done on land of the grantor beyond surveying and staking the line. The land was sold, without any reservation of the right of way, in 1858; and the purchaser and his grantees enclosed and occupied the entire tract until 1886, when defendant railroad company, as successor of the one first named, constructed its road over the land. *Held*, That the making of a survey across the land by the railroad company in 1872, and the sending of a man to take possession of the right of way in 1877, which he did by walking over it, were not sufficient to establish re-entry, as against the continued and actual adverse posses-

sion of the occupants.— Maysville & B. S. R. Co. v. Holton (Ky.), 39 S. W. 27.

4. A finding that possession by one who occupied land concurrently with the legal owner, who was his father by adoption, was not adverse, is supported by evidence that the legal owner exercised full powers of ownership, and never disclaimed title, and that the claimant never asserted ownership during the legal owner's life.— Ward v. Edge (Ky.), 39 S. W. 440 ; Same v. Ward, Id.

5. Where the donee of lands under a parol gift goes into possession, and claims to be the owner, there is the beginning of an adverse possession against the donor.— Schafer v. Hauser (Mich.), 70 N. W. 136.

6. Title to land laid out as a public alley may be acquired by adverse possession.— Vier v. City of Detroit (Mich.), 70 N. W. 139.

7. Adverse possession need not be based on paper title.— Vier v. City of Detroit (Mich), 70 N. W. 139.

8. Possession by an owner or claimant of land beyond the true dividing line between his property and that of another, by mistake or in ignorance of the true line, and without an intention to claim beyond it, is not adverse to the true owner, and will not work a disseizin ; but his possession is adverse as far as his true boundary, though such boundary is not known, and, if continued for 10 years, will sustain ejectment to that line, when ascertained.—Roecker v. Haperla (M. Sup.), 39 S. W. 454.

9. Lands in the "Indian country" cannot be held adversely until the Indians' right of occupancy thereof has been terminated by the United States.— Kreuger v. Schultz (N. D.), 70 N. W. 269.

10. How. Ann. St. § 8698, fixing the limitation on actions for real property, does not require adverse possession to be based on color of title, and one may acquire title by adverse possession, though originally he had no shadow of title.— Ward v. Nestell (Mich.), 71 N. W. 593.

11. Where plaintiff, claiming title to land under deeds thereof, placed a tenant in possession of part of the tract, and

there was no adverse possession in any other person, plaintiff's possession extended to the entire tract.—Zundel v. Baldwin (Ala.), 21 So. 420.

12. Where plaintiff claimed land by adverse possession under color of title, the fact that he was exercising acts of ownership over the land at the time a deed to defendant was made, would not entitle him to recover a part of the land of which defendant was in actual adverse possession at the time plaintiff acquired his possession, and of which defendant thereafter continued in such possession.—Zundel v. Baldwin (Ala.), 21 So. 420.

13. Error in refusing to instruct that, to entitle plaintiff in ejectment to recover under a claim of adverse possession, he need not show any deed, survey, or anything of that kind, as evidence of ownership, is cured by an instruction that plaintiff's adverse possession would become perfect with the lapse of fifteen years, even if he originally had no shadow of title, provided such possession was so open that any other person could bring suit to eject him.—Beecher v. Ferris (Mich.), 70 N. W. 1106.

14. Under the mere possessory right, without color of title, of a person in possession under a parol gift of land, there can be no such thing as constructive possession, which is dependent on title, and, on the death of the occupant, his heir takes no interest in the land unless he continues the actual possession.—Brown v. Watkins (Tenn. Sup.), 40 S. W. 480.

15. Possession under a void deed is sufficient to give a color of title and to set in motion the statute of limitations.—Randolph v. Casey (W. V.), 27 S. E. 231.

16. Mere naked possession of land, without claim of right, is no adverse possession, and, no matter how long continued, will not furnish a defense to an action or confer title.—Parkersburg Industrial Co. v. Schultz (W. Va.), 27 S. E. 255.

17. A partial enclosure of land capable of total enclosure, leaving part of its boundary open, is not sufficient to show adverse possession.—Parkersburg Industrial Co. v. Schultz (W. Va.), 27 S. E. 255.

18. The possession of one who enters upon the land of another as a mere naked trespasser, is limited to so much thereof as he actually occupies; and he cannot claim title by adverse possession to wild and unenclosed land, adjoining that actually occupied and used by him, from the mere fact that he cut natural hay thereon, and let his stock run over and pasture upon it.—Sage v. Larson (Minn.), 71 N. W. 923.

19. Where a settler on vacant land, intending to claim and occupy a quarter section, plowed lines around such quarter, as was the custom in the vicinity, fences not being commonly used, and made such use of all the land within such boundary as was customary among other settlers, his possession may be *held* to have extended to the boundary so marked.—Sage v. Morosick (Minn.), 71 N. W. 930.

20. Where, after enclosure of land, the fence goes to decay, and the land remains open for some three years before the person making the enclosure again takes possession, it does not constitute continuous adverse possession.—Settegast v. O'Donnell (Tex. Civ. App.), 41 S. W. 84.

21. The holder of the legal title to land of which there is no actual occupancy is deemed to be in possession thereof.—Troxell v. Johnson (Neb.), 71 N. W. 968.

22. Plaintiff, a mining company, owned and began mining operations upon a tract of land some time between 1830 and 1835, and has continued to the present time in possession of its mineral deposits by actual mining. Defendant's grantor was employed about said mine by plaintiff, and in 1836 or 1837 entered upon the surface of said land, and began a residence upon and cultivation of six acres of said tract. The company was not engaged in mining immediately under the said six acres. For a period of more than twenty-one years from 1850 the possession of defendant's grantor and his vendees was open, notorious, hostile, and exclusive. *Held*, That, though defendant's grantor acquired a title to the surface of the six acres by limitations, he acquired no interest in the mineral estate, since plaintiff by its acts had severed the mineral estate from the surface, and defendant had actual notice of the

severance.— Delaware & H. Canal Co. v. Hughes, 38 A. 568, 183 Pa. St. 66, 41 W. N. C. 221.

BOUNDARIES.

1. Where a boundary was in dispute, and could not be determined from the deeds, a conclusion that complainant owned the disputed strip, was sustained by findings that it had not been enclosed, that complainant's predecessors had cut grass therefrom and exercised other acts of ownership over it from 1814 to 1893, and that during such time defendants and their predecessors had performed no acts of ownership.— Methodist Episcopal Soc. v. Akers (Mass.), 46 N. E. 381.

2. While occupancy of an adjoining proprietor's land under a mistake as to the boundary line, and without any intention of claiming beyond the true line, is not adverse possession, yet an agreement between the proprietors, both being ignorant of the true line, fixing on a permanent line, followed by possession in accordance therewith, is binding on them and persons claiming under them.— Ernsting v. Gleason (Mo. Sup.), 39 S. W. 70.

3. Direct evidence of an agreement by adjoining proprietors on a permanent boundary line is not necessary, but it may be shown by facts and circumstances, including long acquiescence and recognition, by them and their privies, of a line up to which possession is had, as the division line.— Ernsting v. Gleason (Mo. Sup.), 39 S. W. 70.

4. The center line of a pavement is not the center line of the street, so as to control the boundary line of a lot abutting the street, where the paving was done after the deed to the lot was made, and the lines of the street as described differed from those as laid out by the city, though they agreed with the lines laid out in the paving.— Hastings v. Mc Donough (Sup.), 43 N. Y. S. 628.

5. Maps and descriptions in a deed must be interpreted with regard to the monuments found on the ground; and therefore, where the lines of a street on a map referred to in a deed differ from those laid out by the city before the platting

of the land, the latter prevail.— Hastings v. Mc Donough (Sup.), 43 N. Y. S. 628.

6. On the issue of the true location of a boundary line, a landowner is a competent witness as to the particulars of a survey of the line, where he was present at the survey, and testifies from his own knowledge of the facts.— Wheeler v. State (Ala.), 21 So. 941.

7. The findings of the trial court as to the location of a division line will not be disturbed where the evidence is conflicting.— Ponet v. Wills (Cal.), 48 P. 483.

8. An owner of land, who is not a surveyor, cannot testify in a proceeding between other parties as to the significance of boundary lines on a plat of the land, put there by his direction when the plat was made, the surveyor being dead; since such lines are the declarations of an interested party.— State v. Crocker (S. C.), 27 S. E. 49.

9. On resurvey of land originally belonging to the United States, and which had been surveyed under its authority, the resurvey must follow the boundaries and monuments as run by the original survey, if the monuments can be found, or the places where they were originally placed identified.— Randall v. Burk Tp. of Minnehaha County (S. D.), 70 N. W. 837.

10. Where a fence was regarded by the owners on each side thereof as the true boundary line, in purchasing their adjoining lands, and they and their grantors for more than 30 years believed it to be such, and occupied to it, such fence is thereby established as the true line, though the deeds of the respective owners conveyed the land by the survey.— Palmer v. Dosch (Ind. Sup.), 47 N. E. 176.

11. Where the monuments established by the government surveyors cannot be found, and there is a controversy as to the location of a corner, then courses, distances, and area, as given by the field notes of the United States survey, will control in ascertaining the corners.— Carter v. Hornback (Mo. Sup.), 40 S. W. 893.

12. Where land is described by courses and distances, and also by calls for adjoiners, the latter, where there is a discrep-

ancy, invariably govern.— Airey v. Kunkle (Com. Pl.), 18 Pa. Co. Ct. R. 620, 6 Pa. Dist. R. 1.

13. Where the terms of an old grant, presented to the court of private land claims for confirmation, are ambiguous as to a boundary, there being two objects, either one of which may have been intended, the burden of establishing the further one, including the larger tract, as the true boundary, rests upon the claimant.— Whitney v. United States, 17 S. Ct. 857.

14. Under the New Hampshire rule that in cases of disputed and uncertain boundaries an executed parol agreement establishing a dividing line between adjoining owners of real estate is binding, the line must be actually run to constitute an execution of the agreement, a verbal execution not being sufficient to satisfy the rule.— Glen Manufacturing Co. v. Weston Lumber Co. (C. C.), 80 F. 242; Weston Lumber Co. v. Glen Manufacturing Co., Id.

15. A fence maintained and recognized for years as the upland boundary between two shore lots, extended a board's length below high-water mark. Plaintiff's predecessor in title to one of the lots built a row of piles, commencing at the end of the fence, part way to the channel; and the lot was conveyed to plaintiff after the piling had stood for two years, to the knowledge of, and without objection by, defendants, or their grantors, the owners of the other lot; the piling in fact having been referred to as constituting a boundary in two of the deeds forming a part of their chain of title. *Held*, That the boundary line between their property was established by acquiescence, and consequent estoppel, to the end of the piling, by the line thereof and of the fence; the dividing line thence to the channel being left to be established by the rules of law.— Lowndes v. Wicks (Conn.), 36 A. 1072.

16. The dividing line between two wharf lots on a concave shore being established by acquiescence to a certain point below high-water mark, division from there to the channel is a line drawn from such point perpendicular to a straight line drawn across the mouth of the bend on which the lots are situate.— Lowndes v. Wicks (Conn.), 36 A. 1072

17. Where one owning land including that which would be occupied by a street, if extended, has a survey made to show the street line, and on this sets stakes, and points these out to one to whom he sells lots, and conveys the same with reference thereto, the grantee, taking possession and occupying accordingly, his title to such line, though the surveyor made a mistake in the line, notwithstanding the grantor afterward acknowledges and records a plat including such lots, showing the street line within the lots as referred to the line marked on the ground; the plat, under the provision of Gross's St. 1871, p. 102, not being operative as a conveyance of the streets as located thereon till acknowledged and recorded.— City of Joliet v. Werner (Ill. Sup.), 46 N. E. 780.

18. As against the owner of a lot, who projects his house beyond his lot, erects his fence within the street, and so occupies the lot for over 30 years, the city, by accepting a sidewalk built by him outside, and up to the line, of such fence, and afterward constructing a sidewalk in the same place, levying an assessment therefor, and building a culvert up to the line of the sidewalk, and graveling the street along the side thereof, is estopped to deny that such fence is not the true boundary line.— City of Joliet v. Werner (Ill. Sup.), 46 N. E. 780.

19. On an issue as to the location of land conveyed by courses and distances, it is error to instruct that, if a corner of an adjoining survey was a well-marked corner, the jury might adopt it as a beginning corner in locating the land in controversy, where a calulation from the corner of other adjoining surveys would vary such location, and there is testimony that a corner of the land in controversy was established at the place where the calculation from such other adjoining surveys would locate it, though the corner marks testified to as having been placed there are not mentioned in the deed or field notes of the land in controversy.— Davis v. Coleman (Tex. Civ. App.), 40 S. W. 606.

20. Evidence of undisputed occupation and fencing in accordance with a line for 30 years, not only of the lands in con-

troversy, but of other parcels in the immediate neighborhood, raises a presumption that it is the true line.— Welton v. Poynter (Wis.), 71 N. W. 597.

21. Where the evidence shows a location of a boundary line by adjoining landowners, with the obvious intent of making it the true line, acquiescence therein for 30 years is binding upon the parties and their privies.— Welton v. Poynter (Wis.), 71 N. W. 597.

22. Plaintiff is not estopped to claim the true boundary between her lot and that of defendants, though they respectively occupied for more than ten years to a line on plaintiff's lot, any claim of title thereto by defendants being on the erroneous belief that it was the true line; and though, when defendants, while grading their lot, called plaintiff's attention to a line on the ground, which they had made, and stated they understood it to be on the boundary line, plaintiff answered that she was satisfied that the line was the proper one, and told them to go on with their work; and though she, after they had graded their lot, constructed a temporary retaining wall on the line, there having been at the time no question between them in regard to the location of the boundary, and she not having known till thereafter but that such line was the true boundary. —Jordan v. Ferre (Iowa), 70 N. W. 611.

23. The description in a conveyance of land running to a stake on a river bank, thence up the river to a sycamore on its bank, passes title to the thread of the stream, and carries with it all accretions to the land conveyed.— Runion v. Alley (Ky.), 39 S. W. 849.

24. A patent to a town, which contains a general description of the land conveyed as bounded "on the west by the bounds of Hempstead," a town lying on the west side of a harbor, and a particular description of the westerly boundary as running "on the east side" of the harbor, does not include the harbor, since the general description must yield to the particular one.— People v. Saxton (Sup.), 44 N. Y. S. 211; In re Dana, Id.; In re Duryea, Id.; In re Ladew, Id.; In re North Country Co., Id.

25. Act May 4, 1852 (St. 1852, p. 180), § 1, defined a part of the boundary of the town of Oakland as beginning at a point in the low-tide line; "thence to ship channel; thence northerly and easterly by the line of ship channel to a point where the same bisects said northeasterly line" of the town. *Held*, That the words "thence to ship channel" must be rejected as superfluous.— City of Oakland v. Oakland Water-Front Co., 50 P. 277.

26. Act May 4, 1852 (St. 1852, p. 180), § 1, designated the western boundary of the town of Oakland as "the line of ship channel," extending beyond the line of high tide; and Act April 21, 1851 (St. 1851, p. 305), relating to San Francisco, used the words "ship channel" to mean all navigable waters outside of the bulkhead line as established by law. *Held*, That, as no law established the bulkhead line for Oakland, the court would seek a natural boundary for the ship channel, and, as the low-tide line is the only definite natural line beyond the high-tide line, the low-tide line as it existed May 4, 1852, will be selected.— City of Oakland v. Oakland Water-Front Co., (Cal., 1897), 50 P. 277.

27. The rule in surveying boundaries defined by streams or other waters, is to follow the stream or body of water crossing the mouth of affluents or other inlets from headland to head land.— City of Oakland v. Oakland Water-Front Co. (Cal. 1897), 50 P. 277.

28. In an action in which the question was the correct location of the northeast corner of section 3, it appeared that B., a surveyor, found what he considered the corner stone in a public road which defendant contended was on the section line between sections 2 and 3, and that plaintiff contended such corner was about 25 rods east of such stone. There was evidence that such road was not, and no evidence that it was, located on the section line. *Held* not error to refuse to charge that a long-established road is better evidence of actual boundary settled by practical location than any survey made after the monuments of the original survey have disappeared.— Woodbury v. Venia (Mich., 1897), 72 N. W. 189.

29. It appeared that one W. made a survey, by which he located the corner 25 rods east of such stone, starting from what he claimed was the government corner of sections 34 and 35 in the township north, and following the field notes. *Held* not error to refuse to charge that it was for the jury to determine whether such evidence as was before them of the location of the corners between sections 34 and 35, in connection with the testimony in the case, was of more value in determining the northeast corner of section 3 than a road asserted by defendant to have been on the east line of such section 15 years and more; and that if they were satisfied that the long-continued use of this road in its present location, as contended by defendant, was the best evidence of the location of the east line of the north half of section 3, they would be justified in finding that B. was correct in his location of the corner.— Woodbury v. Venia (Mich., 1897), 72 N. W. 189.

30. It was not error to charge that, "from the evidence submitted to you by these men and other men of the facts and circumstances as they have been developed, all these matters you should take into consideration, and from them determine where the true government survey is, or ought to have been." — Woodbury v. Venia (Mich., 1897), 72 N. W. 189.

31. In the rule that monuments control courses and distances, and that when monuments and measurements vary, the monuments always control, the reference is to monuments and measurements made by the original survey.—Woodbury v. Venia (Mich., 1897), 72 N. W. 189.

32. On an issue as to the location of a section corner, where a surveyor had testified to the location of the corner from the government survey and monuments, a question, on cross-examination, as to whether, according to his survey, certain division lines would not have to be moved, was immaterial.— Woodbury v. Venia, Mich., 1897), 72 N. W. 189.

33. In determining the location of premises by the description in a conveyance, a fixed, visible monument can never be rejected as false or mistaken, in favor of mere course and distance, as the starting point, when there is nothing else in the

terms of the grant to control and override the fixed and visible call.— Garrard v. Silver Peak Mines (U. S. C. C., 1897), 82 F. 578.

34. A survey showed that defendant had built a fence and erected improvements with the south line about six feet further into an alley than the proper location. A former county surveyor testified that in 1861 he found a number of stakes in the alley as located by defendant, who testified that he first built a fence in 1857 according to pegs he found in the ground, and that about 10 years ago he found one of the original pegs. His fences and improvements had been on the same line for over 25 years. The city had since 1872 used the alley, and made improvements therein, without claiming any part within defendant's enclosure. *Held*, The alley was located according to the original survey.— City of Decatur v. Niedermeyer (Ill., 1897), 48 N. E. 72, 168 Ill. 68.

35. The boundaries of a city lot are determined by lines as actually run on the ground as shown by the surveyor's stakes, rather than the lot lines as shown by the plat.— City of Decatur v. Niedermeyer (Ill., 1897), 48 N. E. 72, 168 Ill. 68.

36. Where the last call in the boundary of a patent is "north 20 poles, to the beginning," the line must be run to the beginning though the course is N., 5° 10″ E., and the distance is 141 poles, as the call to the beginning must prevail regardless of course and distance.— Simpkins' Adm'r v. Wells (Ky., 1897), 42 S. W. 348.

37. Where owners of adjoining lands agree upon the dividing line, take and hold possession of their respective tracts, and improve the same in accordance therewith, each party will be estopped from afterward asserting that the line so agreed upon is not the true line, although a sufficient time has not elapsed to raise the bar of the statute of limitations.— St. Bede College v. Weber, 48 N. E. 165, 168 Ill. 324.

38. Mere acquiescence in the location of the division line is not sufficient to establish it, but, when disputed, the preponderance of the evidence must show that the line was agreed upon by the owners of the lands, and that they and their suc-

cessors occupied according to it, and acquiesced in it as such division line.—St. Bede College v. Weber, 48 N. E. 165, 168 Ill. 324.

39. The conclusive effect of a survey establishing a boundary between adjoining owners, made pursuant to statute, may be waived by the parties by agreement or by a new survey.—Spacy v. Evans (Ind., 1897), 48 N. E. 355.

40. To give validity to an oral agreement fixing a dividing line between adjoining lands of antagonistic claimants, it is sufficient that there be a disputed boundary; an actual interference of boundary lines as shown by title papers not being necessary.—Gayheart v. Cornett (Ky., 1897), 42 S. W. 730.

41. A deed described a boundary line as running at right angles with another line, to connect with a third line, "about 50 feet" long. It appeared that, if the corner were made a right angle, the third line would be 53½ feet long. *Held*, That the measurement, being approximate, was controlled by the angle.—Iverson v. Swan (Mass., 1897), 48 N. E. 282.

42. The mere building of a fence on what a landowner supposes to be the true boundary line, without any agreement, does not estop him from claiming title beyond it, though the adjoining owner, acting under the same mistake, has made a slight improvement on the outlying strip.—Iverson v. Swan (Mass., 1897), 48 N. E. 282.

43. Where only the exterior lines of a batch of surveys made in the name of the same warrantee are located, the interior lines separating the individual tracts are to be ascertained according to the rules applicable to the "block system" by reference to monuments made or adopted in the exterior lines; but, where there are marks of the original survey made or adopted for each of the tracts, sufficient to fix the position of their lines on the ground, each tract must be located by following the footsteps of the surveyor, as nearly as the marks he has left behind him will permit.—Morrison v. Seamans, 38 A. 710, 183 Pa. St. 74.

44. Though many of the tracts enclosed by exterior lines are without marks on their lines made for them, yet, if one of

such tracts has original marks on its lines, which were adopted by the surveyor for the location of the tract, such marks will control, the same as if made by the surveyor.— Morrison v. Seamans, 38 A. 710, 183 Pa. St. 74.

45. Where land is sold bordering on a highway, the line is presumed to extend to the center of the highway.— Carpenter v. Buckman (Ky.), 41 S. W. 579.

46. The beginning corner of a survey, as given in the field notes, is of no more dignity than any other corner found on the ground.— Cox v. Finks (Tex. Civ. App.), 41 S. W. 95.

47. Where, in making an original survey, intended to segregate a particular tract of land from the public domain, the surveyor establishes and marks a corner so it can thereafter be identified on the ground as called for in his field notes, such corner will control a call for another object as another corner, when he did not go on the ground, and establish such other corner, but merely supposed that course and distance from the corner established would reach it.— Cox v. Finks (Tex. Civ. App.), 41 S. W. 95.

48. Legal title to the bed of a non-navigable river being vested in the grantor, the grant extends to the center thereof, by the description: "Thence south to the A. river; thence up said river to where it is intersected by the south line of the town."— Hanlon v. Hobson (Colo. 1897), 51 P. 433.

49. So the grant extends to the center of the river by the description: "That fraction lying on the south side of the A. river, and on each side of . . . S. avenue, and extending from the avenue to the river, east and west."—Hanlon v. Hobson (Colo. 1897), 51 P. 433.

50. Where a survey of land borders on a marsh or lake, a strip of three acres of land extending into the water beyond a straight line called for by the surveyor, and shown on a map of the land, is part of such survey; and this, though the law requires the court to follow the footprints of the surveyor in determining the boundary of a given tract.— Bland v. Smith (Tex. Civ. App. 1897), 43 S. W. 49.

51. It appeared that the surveyor, who, in 1794, located a

block of nine tracts, discovered before making his return that he had overstepped the boundary of an older survey 48 rods. He then shortened the lines of the block on his plot that number of rods, and adopted the older survey as an adjoiner on that side. Apparently, from the returns, all the land lost by the mistake was taken from the three tracts abutting on the older survey, instead of being apportioned among the nine tracts of the block by a change of the interior lines. But there was evidence that one of the interior lines had been relocated by marks on the ground parallel with, and 50 rods east of, the line first adopted. *Held*, That while an actual line, run on the ground, and re-marked as the division line of the tracts, would, if proved, control and fix the boundaries of the tracts with relation to each other, yet, as the evidence bearing on the question was contradictory, the court properly left it to the jury to find whether the second line had really been run as a division line of tracts in the block. — Humphrey v. Cooper (Pa., 1898), 38 A. 994, 183, Pa. St. 432, 41 W. N. C. 304.

52. It is error to charge that the intention of a surveyor that a line should run the distance called for in his field notes, rather than to a corner called for, must be determined by evidence outside of the call, in the notes themselves— Mock v. Hatcher (Tex. Civ. App., 1897), 43 S. W. 30.

53. When a witness — a civil engineer — testified to the location of the southeast corner of a block (the facts being disputed as to the place when that corner was originally established) as established by him, by measuring from original stakes, still in existence, and that he measured from such stakes on the west and south exterior boundaries of the block, and by that means established the southeast corner, and from the point so established made his final measurements as testified to on the trial, it was a proper method of establishing such lost corner. — Lewis v. Prien (Wis., 1897), 73 N. W. 654.

54. The unvarying rule to be followed in establishing a lost corner, is to start at the nearest known point on one side of the lost corner, on the line on which it was originally established; to then measure to the nearest known corner on the

other side, on the same line; then, if the length of the line is in excess of that called for by the original survey, to divide it between the tracts connecting such two known points, in proportion to the length of the boundaries of such tracts on such line, as given in such survey.— Lewis v. Prien (Wis., 1897), 73 N. W. 654.

55. All disputes as to the boundaries of land are to be governed by the United States surveys, unless there is some statute to the contrary.— Taylor v. Fomby (Ala., 1897), 22 So. 910.

56. In ascertaining the boundaries of land, where the lines established by the United States survey are obvious, they must be followed, though made on an assumed or wrong magnetic variation; and it is only when lost lines and corners are to be renewed that due allowance should be made for the variation of the magnetic needle from the true meridian.— Taylor v. Fomby (Ala., 1897), 22 So. 910.

57. Where a line was run by certified copies of the original field notes, and by the calls for natural monuments indicated thereon, the location thereof was a fact to be determined by the jury from all the evidence.— Taylor v. Fomby (Ala., 1897), 22 So. 910.

58. In establishing an original line of survey according to the field notes used in such survey, attention is given first to calls for natural or artificial monuments, and, if these are not to be found, to courses and distances, with the variation of the needle from the true meridian as indicated for the original survey on the field notes.— Taylor v. Fomby (Ala., 1897), 22 So. 910.

DEDICATION.

1. Where a lot within the city limits is sold, and bounded by streets designated as such in the conveyance by the owner of the property, it implies a covenant that the purchaser shall have the use of such streets, whether the consideration is valuable or nominal.— Flersheim v. City of Baltimore (Md.), 36 A. 1098.

2. Where, by deed, an owner of land dedicates a street to the public, a delay in opening the street does not defeat the easement.— Flersheim v. City of Baltimore (Md.), 36 A. 1098.

3. Where a grantor conveys a lot bounded by a street owned by him, and designated as such, it is a dedication of the street to the public.— Flersheim v. City of Baltimore (Md.), 36 A. 1098.

4. Where a land company laid out a town site, making a plat on which a certain tract was designated as a park, its authorized agents sold lots with reference to such plat, stating that the tract reserved was a public park, and charging an increased price for lots fronting thereon, and the company improved the tract suitably for park purposes, and refused to pay taxes thereon on the ground that it was a public park, such acts constitute an irrevocable dedication to public use.— Avondale Land Co. v. Town of Avondale (Ala.), 21 So. 318.

5. Where the public had acquired no rights in a way over private land, a grantee of the owner was not estopped to close up the way, as against one of the public who had regularly used it.— Tutwiler v. Kendall (Ala.), 21 So. 332.

6. The fact that the owner of vacant and unenclosed land being put to no present use makes no dissent to the public's traveling over it in a certain route, does not show an intention to dedicate.— Tutwiler v. Kendall (Ala.), 21 So. 332.

7. Comp. St. c. 14, art. 1, § 106, provides that the acknowledgment and recording of the plat of a subdivided tract of land, is equivalent to a deed in fee of such part thereof as is on the plat set apart for streets or other public uses. *Held*, That a plat, properly acknowledged and recorded, showing the subdivision of land owned by E. into lots and blocks, with a block in the center, not traversed by a street or alley, as in case of other blocks, and marked "E.'s Park," operated as a statutory dedication of such block for a public park.— Ehmen v. Village of Gothenburg (Neb.), 70 N. W. 237.

8. When a dedication of a street reserves in writing to the donors the right to designate a portion of the street for railroad purposes, persons subsequently purchasing lots according

to the map, and the agreement of dedication endorsed thereon, with knowledge of the reservation, or where such reservation is stated in the conveyances, are estopped from denying the validity of a city ordinance consenting to the location of a part of such street for railroad purposes, if enough of the street remains for their protection.— Tallon v. City of Hoboken (N. J. Sup.), 36 A. 693.

9. The fact that a railway company has left a portion of its right of way adjacent to a highway unfenced is not a dedication thereof, unless there has been an acceptance.— Sarver v. Chicago, B. & Q. R. Co. (Iowa, 1897), 73 N. W. 498.

10. Code 1873, § 527, which provides that no street dedicated to public use in any city shall be deemed such, unless specially accepted by ordinance, does not apply to towns.— Burlington, C. R. & N. Ry. Co. v. City of Columbus Junction (Iowa, 1897), 73 N. W. 501.

11. The mere extension of the limits of a town so as to embrace ground dedicated as a street is not an implied acceptance of the dedication.— Cochran v. Town of Shepherdsville (Ky., 1897), 43 S. W. 250.

12. Where on a plot there are three squares set apart, designated "Public Square," "Seminary Square," and "Meeting-House Square," the two latter with but an alley between them, and situated several blocks from the former, the dedication of the "Meeting-House Square" will be held to be for religious purposes.— City of Maysville v. Wood (Ky., 1897), 43 S. W.

13. One who platted land adjacent to a city, laying off streets and lots thereon, and sold all the lots to different persons, but made no conveyance of the streets, is not entitled to damages against the city for using the streets in furnishing water and lights to the vendees of such lots. Smith v. City of Goldsboro (N. C., 1897), 28 S. E. 479.

14. When the owner makes a plot indicating the dedication of streets, and sells and conveys lots with reference thereto, the vendee cannot deny such dedication, nor claim damages for the opening of the street.— Higgins v. Borough of Sharon,

5 Pa. Super. Ct. 92, 41 W. N. C. 9; Munn v. Same, 5 Pa. Super. Ct. 103.

15. A dedication by plat is not shown where, before it was acknowledged, the person making the plat had conveyed the premises, and was not the owner thereof.— City of Edwardsville v. Barnsback, 66 Ill. App. 381.

16. Where land was dedicated as a street in 1825, but the city in which it was situated took no steps to open the same, or assert any such right, it was estopped from claiming it in an action in 1895.— City of Edwardsville v. Barnsback, 66 Ill. App. 381.

17. Where a right in land dedicated for a street has been lost by non-acceptance and non-user, an action of forcible entry and detainer will lie against a municipality for an unlawful and forcible entry into and the withholding of the possession from the person in adverse possession of the same.— City of Edwardsville v. Barnsback, 66 Ill. App. 381.

18. The acknowledgment and recording of a village plat vests the legal title to the ground embraced by the streets and alleys in the village; but there must be acceptance by the authorities in order to complete the dedication.—City of Edwardsville v. Barnsback, 66 Ill. App. 381.

19. Where a city acquires rights in a street by a dedication, its rights will be barred by non-acceptance and non-user on its part, and the adverse possession of such premises by private persons and those through whom they claim.— City of Edwardsville v. Barnsback, 66 Ill. App. 381.

20. Where a deed referred to a boundary of the tract conveyed as a road, the land being also owned by the grantor, proceedings by the municipality for its improvement as a street constitute an acceptance of the dedication.— Duffy v. Village of Norwood (Com. Pl.), 3 Ohio N. P. 325.

21. When plaintiff purchased land, his grantor showed him an unrecorded map, which reserved as S. avenue a strip of land of no designated width, which strip was north of that purchased by plaintiff, and was enclosed by a fence. Subsequently the grantor conveyed the strip to another, who had knowledge

of the facts. Plaintiff testified that when he purchased the grantor said that the avenue was a street, and would be kept open, but the grantor denied that he had promised to keep the same open. *Held*, That a finding for plaintiff was sustained.—O'Brien v. Seale (Tex. Civ. App.), 41 S. W. 150.

22. A land owner has a right to revoke an offer to dedicate land for a street where such offer has stood unaccepted for several years, and the land has not been used by the public.—Prescott v. Edwards (Cal.), 49 P. 178.

23. The dedication of a street, resulting from the covenant implied by a conveyance by the owner thereof of abutting land as bounded by such street, is revoked by the conveyance of the bed of the street to the owner of such abutting land before the street is accepted by the public, opened, or in condition for use,—the implied covenant being extinguished by such conveyance.—Clendenin v. Maryland Const. Co. of Baltimore City (Md.), 37 A. 709.

24. Where a vendor marks strips of his land with stakes, and informs the vendee of the abutting land that such strips are streets, and the vendee buys partly because thereof, the vendee takes the right to use such strips as streets, as appurtenant to the land purchased, though his deed described the land by metes and bounds, and made no reference to streets.—Prescott v. Edwards (Cal.), 49 P. 178.

25. Where the owner of a parcel of land to the northern line of which L. street extended sold separate parts of it to two different persons, leaving undisposed of a strip of ground between the two lots conveyed of the width of L. street, and in the later of the two deeds described one of the lines as extending to where a certain avenue intersects the east side of what will be L. street "when the same shall be extended southwardly," this was a dedication of the strip of ground between the two lots as a street.—Kentucky Refining Co. v. Selvage (Ky.), 41 S. W. 288.

26. Where the owner of land makes a plat of it with spaces between the blocks indicating streets and avenues, and sells the blocks and lots with reference to the plat, the purchasers

have the right to insist on keeping the streets and avenues open for public use as such.— Porter v. Carpenter (Fla.), 21 So. 788.

27. The owner of land, after filing a map thereof in 1851, showing certain streets, conveyed various lots as laid down on the map with reference to the streets. The conveyances included all the grantor's interest to the middle of the streets on which the several lots abutted, "subject, nevertheless, to the use thereof by the public heretofore granted and dedicated" by the grantor. The streets were never actually laid out, and there was no evidence of any grant to the public other than the filing of the map. Afterward several conveyances were made of the lots, each containing the clause quoted, until 1873, when all the lots were conveyed to one M. without such clause. *Held*, That the rights of the public in such streets were extinguished at the time of the conveyance to M.— In re Opening of Beck St. (Sup.), 44 N. Y. S. 1087; In re Opening of Fox St., Id.

28. The fact that an owner of land, in platting it, laid out and dedicated a street 66 feet wide, does not tend to show a dedication of a continuation of the street a quarter of a mile south of the street so dedicated.— Samuell v. Town of Sherman, (Ill., 1897), 48 N. E. 576.

29. The recording of a plat is the dedication of the streets to the public, and such dedication includes the whole width of the streets as indicated by the plat.— City of Madison v. Mayers (Wis., 1897), 73 N. W. 43.

DEEDS.

1. In a suit to quiet title, the plaintiff was the grantee named in a deed conveying a lot "except —— feet off the east side of the same." The preponderance of the evidence showed that he had agreed that he would not record this deed until this blank was filled with the width covered by a stairway, to be ascertained subsequent to the execution and delivery of the deed. *Held*, That a decree that the east 4½ feet of this lot, this being the width covered by the stairway, was not

conveyed by the deed, would not be disturbed.—Brown v. Lahart (Iowa), 71 N. W. 355.

2. A statement in a deed conveying certain lots in a city, that the grantor "believes" the lots extend to the middle of the street on which they are located, does not constitute a basis for a claim of anything more than such grantor actually owned. Ashley v. City of Toledo, 13 Ohio Cir. Ct. R. 1, 1 O. C. D. 675.

3. Where there is a shortage on a plat in which the owner intended to plat all his property, such shortage will be divided as near as possible pro rata between the several owners.—C. S. & C. R. Co. v. Tuttle (Cir. Ct.) 7 Ohio, Dec. 63.

4. Where lands have been platted in lots, conveyances by the owner by lot numbers pass the title to the whole, whether or not the lines are correct, the intent to convey all the land being manifest.—C. S. & C. R. Co. v. Tuttle (Cir. Ct.), 7 Ohio, Dec. 63.

5. Where in a description of a city lot, as between lines parallel to a street, words are added erroneously to the effect that the lines are at right angles to another street, the latter words are in law stricken from the deed.—Airey v. Kunkle (Com. Pl.), 18 Pa. Co. Ct. R. 620, 6 Pa. Dist. R. 1.

6. The rule is that as soon as there is an adequate and sufficient definition, with convenient certainty, of what is intended to pass by the particular instrument, a subsequent erroneous addition will not vitiate it.—Airey v. Kunkle (Com. Pl.), 18 Pa. Dist. R. 620, 6 Pa. Dist. R. 1.

7. Conveyance of platted lots which are situated upon the bank of a navigable stream, no part of the bed of the stream being platted, includes all the riparian rights of the grantor in front of said lots to the center of the stream, although such stream is not mentioned in the conveyance. To exclude such rights, they should be reserved or excepted in the deed.—Head v. Chesbrough, 13 Ohio Cir. Ct. R. 354, 7 Ohio, Dec. 176.

8. In a conveyance of described property, "besides" certain other property, the word "besides" cannot be read as "and," or "also," but is to be construed as meaning "in addition to," land previously acquired from the same grantor.—

Philadelphia & T. R. Co. v. Philadelphia & B. Pass. Ry. Co. (Com. Pl.), 6 Pa. Dist. R. 269.

9. Under Code 1873, § 559, providing that descriptions of lots according to the number and designation thereof on the plat shall be deemed sufficient for the purposes of conveyances thereof, and section 561, declaring the acknowledgment and recording of such plat equivalent to a deed in fee simple of lands therein set apart for streets and other public uses, a deed describing the lands thereby conveyed as lots, by numbers as designated in the plat, included only the several parcels so specified therein; as such reference to the lots by numbers, in the deed, had the effect identical with describing them by metes and bounds as delineated on the plat, and therefore included no portion of a vacated street on which they abutted, but to which no reference was made in the deed.— Brown v. Taber (Iowa, 1897), 72 N. W. 416.

10. Though both grantor and grantee in a deed supposed the land described therein was the whole of a certain survey owned by the grantor, the grantee did not acquire title to additional land which in fact formed part of the survey, but which was supposed to belong to another. And the grantor may assert title to such additional land without having the deed reformed, though it calls for a line described as the line of the survey in question.— Bowlin v. Siler (Ky., 1897), 42 S. W. 90.

11. A deed described the property by metes and bounds, adding: "This lot is known as 'Lot No. 13,' . . . and upon this lot the Hotel Bethel is erected." The hotel in fact extended over the line, and covered a part of lot 12. *Held*, That no part of lot 12 was conveyed.— Baltimore Building & Loan Ass'n v. Bethel (N. C.), 27 S. E. 29.

12. The description in a deed was as follows: "Two parcels of land situated in Wise County, State of Texas; one parcel contains 640 acres, and the other parcel contains 320 acres; being one half of two parcels of land patented by B." No other lands were patented by B. in Wise County. Held, That all of the 640 and the 320 acres passed by the deed, since the words "being one-half" are merely words of description, dis-

connected from and contradictory to all words designating quantity, and must therefore be disregarded. Judgment (38 S. W. 834) reversed.— Cartwright v. Trueblood (Tex. Sup.), 39 S. W. 930.

13. Where the owner of land plats it into lots, and sells with reference to the plat, the purchasers of lots abutting on an alley shown on the plat acquire a vested right therein; and though such alley, after being used many years as a highway, is afterwards enclosed by the lot owners, it cannot be recovered from them by the platter or his heirs.— Bond v. Texas & P. Ry. Co. (Tex. Civ. App.), 39 S. W. 978.

14. An impossible or senseless course given in a deed must be disregarded; and, if the other calls or parts of the description are sufficient to identify the land conveyed, the deed will be sustained.— Brose v. Boise City Railway & Terminal Co. (Idaho, 1897), 51 P. 753.

15. The evident intention of parties to a deed must be given effect, the same as in other writings.— Hale v. Docking (Kan. App., 1897), 51 P. 798.

16. General words in the habendum cannot control or govern special words of limitation used in the grant or premises of a deed.— Hunter v. Patterson (Mo. 1898), 44 S. W. 250.

17. In determining the true construction of a deed, the habendum clause is not absolutely controlling. The real question is, What was the intention of the grantor, to be gathered from the entire instrument, and not inconsistent with any rule of law? 1 Rev. St. P. 748, § 2.— Harriot v. Harriot, 49 N. Y. S. 447.

DRAINS.

1. Proceedings by a reclamation district under Pol. Code, § 3493½, to establish the validity of an assessment by it, wherein all objections are heard before the bringing of an action on the assessment, is in the nature of a proceeding in rem, and hence a plea of consular privilege is not available therein.— Reclamation Dist. No. 551 v. Runyon (Cal.), 49 P. 131.

2. In a proceeding by a reclamation district to establish the validity of an assessment by it, defendant may show that the assessment of his property is excessive and unfair.— Reclamation Dist. No. 551 v. Runyon (Cal.) 49 P. 131.

3. Under statutory proceedings in the circuit court, a drain was completed nearly three years after its establishment, whereupon an intervening petition was filed, seeking allowance for damages resulting to land by reason of the drain which it was alleged could not have been forseen at the time the petitioner was notified to appear, and make any remonstrance she saw fit to the damages or benefits assessed. *Held*, that the petition was properly stricken from the files in view of Rev. St. 1894, § 5625, which provides that, where the finding of the court is against remonstrances made, the confirmation of assessments made by the commissioners should be final and conclusive.— Haefgen v. Harness (Ind. Sup.), 47 N. E. 470.

4. One who fails to remonstrate, as provided by statute, to benefits or damages assessed to property in proceedings for the construction of a drain, is as much barred by the judgment as though he had remonstrated, and an adverse judgment had been rendered.— Haefgen v. Harness (Ind. Sup.), 47 N. E. 470.

5. How. Ann. St. § 1740b5, provides that the applicants for a drain shall be liable for all costs and expenses in case the commissioner shall determine that the same is unnecessary or impracticable, or in case the proceedings shall be dismissed for other cause; section 1730c6, that the commissioner shall dismiss the proceedings, at the cost of the applicants, in case such drain shall be decided to be unnecessary; and section 1730c4, that, on review on certiorari, the applicants for the drain shall be liable for the costs in case the proceedings be not sustained. *Held*, That the applicants are liable for the costs of the proceedings at any stage when dismissed or quashed for any cause not due to the negligence or fault of the commissioner.— Case v. Telling (Mich.), 71 N. W. 510.

6. The owners of swamps, the waters of which naturally flow into natural water-courses, can make such canals in the swamps as are necessary to drain them of the water nat-

urally flowing therein, though in so doing the flow of water in the natural water-course is increased, whereby the water is discharged on land of a person abutting on such water-course.— Mizell v. Mc Gowan (N. C.), 26 S. E. 783.

7. Pub. Acts 1885, No. 227, c. 3, § 12, provides that in case commissioners appointed to ascertain the compensation to be made for land taken for a public drain shall decide such drain to be unnecessary, they shall so state in their return, and the drain commissioner shall thereupon dismiss the proceedings, and no further application for the same object shall be entertained within one year thereafter. *Held*, That the statute does not apply where the commissioners fail to agree, in which case new commissioners may at once be appointed.— Parker v. Lincoln (Mich., 1897), 72 N. W. 173.

8. Two drain commissioners of different counties, who are acting jointly, as required by 3 How. Ann St. § 1740g7, in laying out a drain through the counties represented by them, must both be made parties to a writ of certiorari brought to remove proceedings by them to the circuit court of one of the counties.— Duflo v. Lillibridge (Mich., 1897), 72 N. W. 181.

9. 3 How. Ann. St. § 1740b5, providing that a petition to establish a drain shall be "signed by not less than five freeholders of the town or townships in which such drain or the lands to be drained thereby and to be assessed therefor may be situated, one or more of whom shall be owners of lands liable to be assessed for the benefits," does not require the petition to be signed by five freeholders of each township where the drain traverses more than one township.— Brady v. Hayward (Mich., 1897), 72 N. W. 233.

10. 3 How. Ann. St. § 1740b7 (Drain Law, c. 3, § 3), providing that on the filing of an application the commissioner shall examine the proposed drain, and if, in his opinion, it is necessary and conducive to the public health, convenience, "or" welfare that the application should be granted, he shall proceed with its construction, is not unconstitutional, as failing to require a finding that the drain is necessary for the public health.— Brady v. Hayward (Mich., 1897), 72 N. W. 233.

11. Pub. Acts 1895, No. 217, merely amended some sections of the general drainage law to remedy certain defects, and did not purport to take the place of the old law; and hence proceedings already commenced were not intended to fail because of the amendments, but were to be completed subject to the provisions of the law as amended, so far as applicable.— Brady v. Hayward (Mich., 1897), 72 N. W. 233.

12. Under 3 How. Ann. St. § 1740b5, requiring a petition for the establishment of a drain to "give a general description of the beginning of the route and the termination thereof," a description of the drain as the portion of a natural water-course to be widened and deepened from a point where it intersects a certain section line, thence in a northwesterly direction up stream, through certain specified sections, to a designated terminus, is sufficient.— Brady v. Hayward (Mich., 1897), 72 N. W. 233.

13. 3 How. Ann. St. § 1740d8, providing that after a drain is proposed the commissioner shall divide it into sections for letting the work, is directory only, and the fact that the commissioner established one section 15 miles long is immaterial, though the length of the entire drain was but 19 miles.— Brady v. Hayward (Mich., 1897), 72 N. W. 233.

14. 3 How. Ann. St. § 1740i6, provides that the State board of control shall no longer exercise control over drains constructed by the State. Section 1740a7 provides that the jurisdiction of the town drain commissioner shall be limited to drains wholly within his township, and that the county drain commissioner shall have concurrent jurisdiction with the township drain commissioner, "and shall also have jurisdiction over all other drains within his county." Section 1740h9 provides that drains theretofore constructed under any provision of law may be widened and deepened "under the provisions of this act." *Held*, That where a drain traversing more than one township is laid over a portion of an old State drain, a stream which is to be widened and deepened, the county commissioner is not deprived of authority.— Brady v. Hayward (Mich., 1897), 72 N. W. 233.

15. Under 3 How. Ann. St. § 1740e, providing with reference to drains, that the commissioner shall "proceed to receive bids and let jobs for the construction of the sections, and make contracts with the lowest responsible bidder giving adequate security for the performance of the work," where the commissioner has established an unsually long section, which will involve a large expenditure for its construction, he may require bidders to accompany their bids with a check as a guaranty that the person to whom the contract is awarded will enter into it.— Brady v. Hayward (Mich., 1897), 72 N. W. 233.

16. The fact that a drain is a running stream, and is created by deepening and widening it, does not render the work an internal improvement, within Const. art. 14, § 9, prohibiting the State from becoming a party to or interested in an internal improvement.— Brady v. Hayward (Mich., 1897), 72 N. W. 233.

17. The legislature may lawfully authorize the laying of drains in highways, and the alteration thereof, by other officers than those having the highways in charge.— Kiley v. Bond (Mich., 1897), 72 N. W. 253.

18. The county drain commissioner will not be enjoined from widening a drain in a highway on the ground that it will amount to a discontinuance of such highway, where the erection of barriers, as provided by law in cases where natural water-courses unduly encroach upon highways, will render the road fit and safe for public travel.— Kiley v. Bond (Mich., 1897), 72 N. W. 253.

19. 3 How. Ann. St. § 1740e2, as amended (Laws 1895, p. 229), providing that the cost of constructing a drain shall be apportioned on the basis of the per cent. of benefit to the public health, or as a means of improving any highway, and also against lands according to the per cent. of benefit, is not unconstitutional, as failing to make the apportionment in dollars and cents, since the fact that a drain is established involves a finding that it is necessary and conducive to the public health, and it must be presumed that the drain is worth all that it costs. — Brady v. Hayward (Mich., 1897), 72 N. W. 233.

20. Where the commissioner, in establishing a drain, acted

in good faith in procuring the right of way, and obtained a release from all the parties except certain of several tenants in common, and all those who had a right to complain have done so in court, and have not appealed, and no owners of lands traversed by the drain are complaining, a person merely assessed for benefits, and whose land is not invaded, cannot be heard to complain of irregularities in the proceedings to establish the drain.— Brady v. Hayward (Mich., 1897), 72 N. W. 233.

21. The drainage act of July 10, 1893, § 6, is not unconstitutional because it directs the viewers to "estimate the damages, if any, that any person or persons will sustain by reason of the construction of such ditch, and assess such damages to the parties owning the lands benefited," since, by a fair construction, the assessment cannot go beyond the benefits.— Duke v. O'Bryan (Ky.), 39 S. W. 444.

22. A proceeding under the drainage act of July 10, 1893, is not for private benefit where the application alleges that the proposed drain is necessary for "public and private health, convenience, and welfare," and the public utility is kept prominently in view throughout the whole case.— Duke v. O'Bryan (Ky.), 39 S. W. 444.

23. Where a drainage district has been legally organized, the commissioners have no power to change its boundaries except by a dissolution, under 3 Starr & C. Ann. St. p. 448, § 47½, relating to the dissolution of drainage districts. 61 Ill. App. 416, affirmed.— People v. Drainage Commissioners of Union Drainage Dist. No. 1 (Ill. Sup.), 46 N. E. 261.

24. An order by the drainage commissioners rescinding a prior invalid order, limiting the extent of a district duly organized, was not illegal, as an extension of the boundaries of the district.—People v. Drainage Commissioners of Union Drainage Dist. No. 1 (Ill. Sup.), 46 N. E. 261.

25. The amended drain law (Pub. Acts 1893, p. 335, c. 6, § 6) provides that, in all cases where suit is brought "against the collector," arising out of the collection of any drain tax, the "township" or "county," according as the tax shall be for

a township or county drain, shall "defend such officer" in the same manner that he has now the right to be defended in the collection of general taxes; and no suit shall be instituted to recover any drain tax, or money paid, or property sold therefor, or for damages on account thereof, unless brought within 30 days of the time of payment of such money to, or sale of such property by, the collecting officer; and, "if such tax shall be paid under protest, the reason therefor shall be specified, and the same procedure observed as is or may be required by the general tax law." The general tax law (Pub. Acts 1885, No. 153, § 42) provides that a person may pay any tax to the treasurer, under protest, specifying at the time, in writing signed by him, the grounds of such protest, and the treasurer is required to minute the grounds of such protest on the tax roll and in the receipt given; and "the person paying under such protest may, within 30 days, and not afterward, sue the township for the amount paid," etc. *Held*, That the clause above quoted should be construed as having reference to the protest and the action of the officer to whom the money is paid, and not as intended to give a right of action against the township.—Hillyer v. Township of Jonesfield (Mich., 1897), 72 N. W. 619.

26. Unless properly assigned for error, an alleged defect in the petition for the appointment of three disinterested freeholders as drain commissioners cannot be considered by the court on appeal.—Roberts v. Smith (Mich., 1897), 72 N. W. 1091.

27. Objections to proceedings for the establishment of a drain on the ground that the drain commissioners were interested parties cannot be considered unless the matter was raised by a proper assignment of error.—Roberts v. Smith (Mich., 1897), 72 N. W. 1091.

28. Where the advertisement for the letting of a county contract for the digging of a ditch is that "said job will be let by sections," there must be an offer to let it in sections before it can be let as an entirety.—Smith v. Board of Sup'rs of Livingston County (Mich., 1897), 73 N. W. 118.

29. Where the probate judge appoints a committee of freeholders to assess the amount which the upper county is to pay the lower county for the proposed outlet of a ditch, and such committee makes a report to the probate court, he may modify such report, either by increasing or diminishing the amount stipulated in it, or may set it aside, and send out a new committee to report.— Board Com'rs Wood County v. Board Com'rs of Ottawa County (Ohio Cir. Ct., 1897), 7 Ohio Dec. 593.

30. Under Rev. St. 1894, § 5656 (Rev. St. 1881, § 4286), which provides that the drainage authorities shall accurately describe each parcel of land, giving the number of acres assessed and the number benefited, it is proper, when only two acres of a 40-acre tract are benefited by drainage ditch, to assess such benefit against the whole tract.— Drake v. Schoenstedt (Ind., 1897), 48 N. E. 629.

31. The court cannot assume that the special drain commissioners were interested in the proceedings before them from the fact that they were assessed for a drain which leads into the one proposed and involved before them.— Roberts v. Smith (Mich., 1897), 72 N. W. 1091.

32. Assessment for the expense of a drain is not taking private property under the power of eminent domain.— Roberts v. Smith (Mich., 1897), 72 N. W. 1091.

NAVIGABLE WATERS.

1. Under the law of France prevailing in the Illinois territory in 1743, islands formed between the thread of the stream and the shore became the property of the riparian proprietor.— President, etc., of Kaskaskia v. Mc Clure (Ill. Sup.), 47 N. E. 72.

2. A grant by the government is to be construed according to the common law, and where the grant bounds on streams not navigable by the common law, it entitles the grantee to all islands lying between the mainland and the center of the thread of the current.— President, etc., of Kaskaskia v. Mc Clure (Ill. Sup.), 47 N. E. 72.

3. One's ownership of mainland on the shore of one of the Great Lakes does not make him owner of an island lying therein 600 feet from the shore.— Sherwood v. Commissioner of State Land Office (Mich.), 71 N. W. 532.

4. Riparian owners have no right to construct wharves and other improvements in front of their lands on tide lands owned by a city, where it will obstruct and deflect the flow of the water.—Murphy v. Bullock (R. I.), 37 A. 348.

5. The question as to the nature and extent of the rights of riparian owners upon navigable waters, including the right to the continued flowage of the stream, is one to be decided by the courts of the State as a matter of local law, subject to the right of Congress to regulate public navigation and commerce. — St. Anthony Falls Water-Power Co. v. Board of Water Com'rs of City of St. Paul, Minn., 18 S. Ct. 157, 158 U. S. 349 ; Minneapolis Mill Co. v. Same, Id.

6. The provision of the Minnesota enabling act (11 Stat. 166) declaring the Mississippi River a common highway for the inhabitants of the State, and all other citizens of the United States, does not impair the title and jurisdiction of the State over the navigable waters within her boundaries any more than rights of that nature are limited with regard to the thirteen original States.— St. Anthony Falls Water-Power Co. v. Board of Water Com'rs of City of St. Paul, Minn., 18 S. Ct. 157, 158 U. S. 349 ; Minneapolis Mill Co. v. Same, Id.

7. In order to be a navigable stream it is not necessary that the waters shall be deep enough to admit the passage of boats at all portions of the stream. The Mississippi, in the region of the falls of St. Anthony, Minn., is to be classed as a navigable river, being navigable in its natural state both above and below the falls and the adjacent rapids.— St. Anthony Falls Water-Power Co. v. Board of Water Com'rs of City of St. Paul, Minn., 18 S. Ct. 157, 158 U. S. 349 ; Minneapolis Mill Co. v. Same, Id.

8. While the general rule prevents any disturbance of riparian rights by public authority, past or present, without making compensation, it is the rule in New York, when the interests of

the whole people require an improvement of the water front of a navigable stream for the benefit of commerce, for the State, or the city of New York by permission of the state, to make such improvements upon the tide-water front without compensating the riparian proprietor, except by giving him a pre-emptive right to purchase in case of a sale. Judgment, 41 N. Y. S. 939 (1896), affirmed.— Sage v. City of New York (N. Y., 1897), 47 N. E. 1096, 154 N. Y. 61.

9. Although, as against individuals, riparian owners have special rights to the tideway between high and low water mark, which are recognized and protected by law as against the general public, as organized and represented by government, they have no rights that do not yield to commercial necessities, except the right of pre-emption, when conferred by statute, and the right to wharfage, when protected by a grant and covenant on the part of the State; and any grant of land on tide-water is subject to an implied reservation of the right to improve the water front to aid navigation, for the benefit of the general public, without compensation to the riparian owner. Judgment, 41 N. Y. S. 939 (1896), affirmed.— Sage v. City of New York (N. Y., 1897), 47 N. E. 1096, 154 N. Y. 61.

10. The grant by Governor Nichols in 1667 to the inhabitants of the village of New Harlem of certain lands, bounded on the east by the Harlem River, did not convey to the grantees any rights in the tideway along the bank of the river, as against the public right to improve it for the benefit of commerce; and the city of New York, under the grant of the tideway made by Governor Dongan in 1686, confirmed by Governor Montgomerie in 1730, and by the colonial legislature and the constitution of 1777, acquired the right to fill in the land between high and low water mark, and build wharves or other structures thereon, in the interest of commerce, without making compensation to the owner of upland. Judgment, 41 N. Y. S. 939 (1896), affirmed.— Sage v. City of New York (N. Y., 1897), 47 N. E. 1096, 154 N. Y. 61.

11. Land made by filling in the space between high and low water mark, under the right of the city of New York to

improve the tideway for the benefit of commerce, does not become the property of the riparian proprietor, as an accretion, but remains, as dry land, the property of the city, under its grants, as much as when it was still land under water. Judgment, 41 N. Y. S. 939 (1896), affirmed.—Sage v. City of New York (N. Y., 1897), 47 N. E. 1096, 154 N. Y. 61.

12. The term "strand" is synonymous with "shore," and is that portion of the land lying between ordinary high and low water marks.—Stillman v. Burfeind, 47 N. Y. S. 280, 21 App. Div. 13.

13. At common law, grants of land bounded by the sea or navigable rivers where tide ebbs and flows extend to ordinary high water mark.—Stillman v. Burfeind, 47 N. Y. S. 280, 21 App. Div. 13.

14. Land formed by accretion in the angle of a dock and shore belongs to the persons having absolute ownership of such dock and shore.—Roberts v. Brooks (C. C. A.), 78 F. 411.

15. In 1820, plaintiff's island was separated from the south bank of the Missouri River by the main channel; but by 1858 it had washed away at one end, while accretions formed at the other end, and the main channel, had covered most of the original area, while the rest was occupied by sand-bars which had pushed out from the south bank of the river. In 1875 the main channel abruptly shifted to the north side of the island, leaving the abandoned river bed between the island and the sand-bars. *Held*, That the plaintiff had no title to land forming a part of said sand-bars within his original boundaries.—Vogelsmeier v. Prendergast (Mo. Sup.), 39 S. W. 83.

16. Where the channel of a navigable stream abruptly shifts from one side of an island to the other, the island owner acquires no title to the abandoned bed.—Vogelsmeier v. Prendergast (Mo. Sup.), 39 S. W. 83.

17. The extension of the upper of adjoining piers 40 feet into a shallow channel of a broad, navigable river does not "impair navigation, commerce, or anchorage," within the river and harbor act (25 Stat. 425), as amended by 26 Stat.

454, § 7, where the channel does not extend above the upper pier, and is seldom traversed, and then by vessels of but small capacity, and principally by the pier owners, and the extension does not obstruct the vessels of the lower owner in reaching their pier, but destroys merely the facility with which they may be warped along and moored to its side.—Jenks v. Miller (Sup.), 43 N. Y. S. 927.

18. One who erects a pier in front of his upland, on lands under water, granted him by the State, acquires no exclusive right to waters in front of adjacent proprietors; hence he cannot enjoin the erection, otherwise lawful, of a pier which will cut off a side approach to his pier.—Jenks v. Miller (Sup.), 43 N. Y. S. 927.

19. An artificial ditch connecting with a navigable stream, but constructed by private parties for the benefit of adjacent property, and which has been filled up by the owners of such property for most of its length, and abandoned for the uses for which it was designed, is not a public, navigable water way, and is subject to condemnation for public purposes.—Ligare v. Chicago, M. N. R. Co. (Ill. Sup.), 46 N. E. 803.

20. The United States has the right to make improvements upon submerged land, necessary for the aid of navigation, without compensation to the owner thereof, and where access to the open water is thereby cut off.—Scranton v. Wheeler (Mich.), 71 N. W. 1091.

21. A conveyance of platted lots which are situated upon the bank of a navigable stream, no part of the bed of the stream being platted, includes all the riparian rights of the grantor in front of said lots to the center of the stream, although such stream is not mentioned in the conveyance. To exclude such rights they should be reserved or excepted in the deed.—Head v. Chesbrough (Com. Pl.), 4 Ohio N. P. 73.

22. Where the right of navigation is not impaired, possessory rights to tide lands in Alaska will be determined by the rules governing similar rights to uplands.—Carroll v. Price (D. C.), 81 F. 137.

23. In a suit to determine the boundaries of the respective portions of the flats, lying between the shore-line and the line of navigability, to which riparian owners were entitled, it appeared that the line of navigability formed two sides of a right-angled triangle, of which the shore-line was the hypotenuse. *Held*, That the line of navigability should be subdivided and apportioned among them in the same proportions that the portions of the shore-line owned by each bore to the whole shore-line, and that each owner was entitled to such portion of the flats as would be bounded by lines drawn from the termini of his portion of the line of navigability to the termini of his portion of the shore-line, and that the entire line of navigability, and not merely one side of the triangle, must be so apportioned, irrespective of the fact that one part was less valuable than another.— Groner v. Foster (Va.), 27 S. E. 493.

24. In apportioning among riparian owners the respective portions of the flats, between the line of navigability and the shore-line, to which they are entitled, the low-water mark must be taken as the shore-line, under Code, § 1339, providing that the limits of the several tracts of land lying on the shore, and the rights and privileges of the owners of such lands shall extend to low-water mark.— Groner v. Foster (Va), 27 S. E. 493.

25. The port warden's line, as defined by the board of harbor commissioners, was binding on the court in apportioning among riparian owners the respective portions of the flats, between the line of navigability and the shore-line, to which they were entitled, under Acts 1881–82, c. 205, p. 216, and Acts 1883–84, c. 148, p. 184, authorizing the board of harbor commissioners of Norfolk and Portsmouth to define the port warden's line along the water front, and to fix the lines within which riparian owners may erect wharves, docks, and other structures.— Groner v. Foster (Va.), 27 S. E. 493.

26. The right of the public in a navigable stream does not extend to use of lands of a riparian owner not covered by water. And where a builder of vessels moored in the stream

carries lines from them across the river bank of such riparian owner, against his objection, and fastens them upon the land of such builder, and insists upon the right to continue such acts, the riparian owner may be entitled to an injunction, although his land is unimproved, and such acts produce no actual present damage.— Pollock v. Cleveland Shipbuilding Co. (Sup.) (Ohio, 1897), 47 N. E. 582.

27. Where a government survey lays down a meander line next to a lake, and the plat returned to the general land office, and referred to in the patents to identify the lands granted, exhibits the granted tracts as bordering upon the lake, the waters of such lake, and not the meander line, is the boundary of the lands conveyed.— Kirwan v. Murphy (U. S. C. C. A., 1897), 83 F. 275.

REPORT OF COMMITTEE ON DRAIN LAWS AND LEGISLATION.

E. STRONG, CHAIRMAN.

THE short time between the last annual meeting and the end of time to *introduce* new measures in the last legislature, made it necessary for me to act at once, without losing any time in consulting with the other members of the committee, and I hope you will be so kind as to overlook what might otherwise be considered a breach of etiquette.

The committee are glad to be able to report that very much has been done and finished up in drain legislation since the last annual meeting. All that was asked for has been done and done willingly; and the recommendations of this society upon the subject of drain law requirements have passed at their face value. The glaring defects in the law have been pruned away. Many alterations for the better have been made, and a few new features have been introduced. One new clause is so wonderfully important and useful that it now seems strange that no one thought of it before. It requires all objections to the regularity of the drain commissioner's proceedings to be made within ten days of the signing of the final order of determination; so now, after the work is done, the orders issued, and the tax spread and being collected, a suit cannot be entertained to set aside the tax on the ground that the commissioner has erred. However, there are some sins, I fancy, that this cloak will not be allowed to cover. The credit of suggesting this amendment is probably due to Mr. Albert Little, Kalamazoo County commissioner. I have seen him, the past summer, successfully resist a suit by pleading this clause. And it is with considerable interest that the commissioner watches for the passing of the ten days, especially if he has caught himself tripping. And where is the commissioner who does not at times feel afraid of himself, as he looks over,

in the Michigan reports, the long line of the bones of his predecessors? He remembers the boastful threat of lawyers, in the past, to lay *him* out in the procession with the others, where he can count one more in the general disaster. It is with pardonable satisfaction that he takes his cane or Jacob staff and walks out to behold the sunset of the tenth day. Of course, the ten days of appeal from the apportionment are not to be confounded with the other ten days. It is of importance that the second order of determination should be signed as soon as the law allows.

No peculiar means were employed to secure this drain legislation; but a strong chain of circumstances combined to bring it about. The great necessity of an improvement was recognized in every part of the State, and all concerned were ready to listen to suggestions and discuss changes. At the suggestion of the attorney-general, a new copy of the Drain Law was annotated in red ink with the changes recommended. These changes were as carefully written and fitted to the old text as possible. The secretary of this society also had a hand in this revision, and very materially assisted in the final hours that intervene between the action of the house committee and the passage of the bill. These are hours of danger in which an enemy can, by the insertion of a single word, destroy the usefulness of a measure. This was done twice in this instance, as the secretary will explain to you. I have been told, and have reason to believe, that this was the very manner in which the old law was made so exceedingly objectionable. I have been given even the name of the party who tampered with these bills in one instance. But as there is a doubt, it is best to give him the benefit of the doubt, and this is only mentioned as a matter of caution to any one who expects to engineer a bill through the rocky rapids of legislation.

The new Drain Law has been tested the past summer in Kalamazoo County in ten drains, aggregating twenty miles, with about four cases in court, and so far has worked well and with comfort to the commissioners. He has only one addition to the law to suggest, and that is, to allow the commissioner to

draw orders bearing interest from date in certain cases. First, where orders wait until the second year for payment. Second, to enable him to announce before letting, that he will pay in orders bearing interest from date. This greatly facilitates the letting of contracts; so much so that the careful commissioner will find it necessary to caution inexperienced bidders.

MICHIGAN ENGINEERING SOCIETY.

ANNUAL CONVENTION AND BUSINESS TRANSACTIONS.

The nineteenth Annual Convention of the Michigan Engineering Society was held in the parlors of Hotel Harrington, in Port Huron, beginning Dec. 28, 1897. An address of welcome was given by Mayor Boynton, to which President F. F. Rogers responded, and addressed the society as follows: —

RESPONSE.

Mr. Mayor, we thank you most heartily for this cordial welcome to Port Huron, and only hope that you and the citizens will form no unfavorable opinion of us during our brief stay. While the society is not so large in numbers as many that visit your city, we think we can say, without boasting, that the engineers have done as much as the men in any other profession to cause the marvelous and magnificent development along all industrial lines that we are so proud of in the closing years of this nineteenth century.

The surveyor has ever been the advance pioneer of civilization. He has marked the bounds for countless numbers of freeholders, in the forests and on the prairies of this vast country, years before their settlement was assured. He has traced the lines for numerous railroads from the rocky shores of New England to the sunny slopes of the Pacific, with a vast network of connecting lines spreading like a web over this continent. He has spanned our rivers and cañons with bold and magnificent bridges. He has directed the miner in his search for earth's hidden treasures.

He has constructed buildings large enough to harbor a whole community. He has brought wholesome water into our dwellings, and told us how to remove household and shop wastes in the least offensive and most sanitary manner. In

fact, can any one name a successful industry of any magnitude in which the best knowledge of the engineer has not been used?

Our Michigan society may not cherish among its members a Hobson of tunnel fame, or any other man who has directly designed an engineering object of special wonder; but it does contain many honest, hard-working, practical engineers, capable of successfully coping with the thousand varied details of their daily practise, and this has fitted many of them to superintend greater works, as occasion may demand. Had it not been for slavery and the Civil War, we would never have known much about Lincoln or Grant. Had it not been for the construction of St. Clair tunnel, we would never have heard much about Joseph Hobson, and who shall say that we have not men in our own ranks who can successfully cope with vaster problems than have ever yet been presented. We will trust that this is true.

To me it has always been a consolation to think that while my lot has been a humble one, there are men in our profession whom we can rightfully call brothers, that are worthy of as much respect and admiration as can honestly belong to any mortal on earth.

A word about our society. I wish that I had the ability to tell in words that all young men would heed, the great value that this society has been to me personally. The society, with its papers, discussions, and acquaintances, has been a sort of post-graduate course, and has enabled me, especially in my early practise, to handle successfully problems over which, without this aid, I must have stumbled. I have ever found its older members free to advise me on all questions whenever I desired information. If for no other reason than that of the acquaintance with older and abler engineers, the young man cannot afford to rob himself of this class of association. Each year I have gone from our sessions with a nobler and more determined ambition to do my best in the work that lay before me. However much like drudgery the work in hand may have been, I have felt that our ranks contained many of "Nature's noble-

men," some of whom had traveled, or were still traveling, the same rough pathway.

Our society in the past has done much good work. The Hodgman "Manual of Land Surveying" may be said to be a product of this society, without in any degree detracting from the great labors bestowed upon it by our worthy secretary. Our earlier proceedings discussed and practically exhausted all the problems of land surveying. All surveyors need these reports.

Lately we have taken up work along certain lines by standing committees, which I commend very much. I do not know how we can extend our usefulness except along these lines. The questions of improved streets and modern methods of sewerage and sewage disposal are growing every year, and we must continually glean the latest knowledge, if we would be up-to-date in these matters. Monograph descriptions of systems of water-supply and sewerage are now much-desired articles for our conventions.

Our membership includes surveyors and civil and mechanical engineers, and we should seek such variety in our programs as to make our proceedings of interest to all classes. To do this successfully, the officers need the hearty co-operation of all members. We are thankful for your generous responses in the past, and hope you will continue to assist the present management to keep our society what it ever has been,— one of the best of the State societies.

I thank you most sincerely for the honor you have conferred upon me by electing me to this office, and I shall strive hard to keep pace with a worthy line of predecessors.

Following this came the various papers and discussions on the program printed elsewhere. On Wednesday P. M. the society was given an excursion through the tunnel, concerning which Mr. Ryan, assistant city engineer of Port Huron, had read a paper in which were compiled the leading facts relative to its construction. While waiting at the depot, the artist of the party, Mr. Dan T. Albertson succeeded, in spite of unfavorable, conditions, in getting some very good views of the locality, one of which is reproduced here.

The business meeting of the society was held on their return from the excursion, and the following business transacted: —

The secretary's report of the annual meeting of the Board of Directors was read and approved. It is as follows: —

SECRETARY'S REPORT OF THE ANNUAL MEETING OF THE BOARD OF DIRECTORS, SEPT. 15, 1897.

The annual meeting of the Board of Directors of the Michigan Engineering Society was held at Hotel Downey in Lansing,

WM. APPLETON. DORR SKEELS.

Sept. 15, 1897. There were present Vice-President Rogers, Secretary Hodgman, Directors Sears and Skeels, and Member Wm. Appleton. The ballots for officers were canvassed, and the following persons declared elected: President, Frank F. Rogers, of Port Huron; Vice-President, J. J. Hubbell, of Manistee; Secretary-Treasurer, F. Hodgman, of Climax; Directors, Dorr Skeels, Wm. B. Sears, and C. E. Greene.

The annual report of the secretary was read and approved. The applications of Adolph Barthel and Seth Dean for with-

drawal were granted. The memberships of L. M. Davis, Henry Melchers, and A. L. Marhoff were annulled for non-payment of dues. The treasurer's annual report was read and approved. The following by-law relative to Honorary Membership was considered and approved: —

4. Senior members of this society who have held such membership continuously for ten years, or who by reason of active and earnest work for the society shall have won the rank of Honorary Member, or who on account of age or other reason shall desire to lay aside their active duties, shall be eligible to the election of the grade of Honorary Member.

Engineers not members of this society who have achieved marked success in the practise or teaching of the profession, or persons who have made valuable original investigations in any science which is of aid to the engineering profession, or persons of great scientific learning, shall be eligible to the grade of Honorary Member; but at no time shall there be more than ten Honorary Members who shall not have been eligible from an active senior membership.

All candidates for the grade of Honorary Member shall be nominated by majority of the Board of the Directors, and shall be elected by letter ballot in the manner prescribed for the election of other members.

It was determined to hold the next Convention at Port Huron the last week in December (28, 29, and 30), and President Rogers was put in charge of local arrangements.

F. Hodgman, *Sec.*

On Motion of Prof. J. B. Davis the by-law relative to Honorary Membership was adopted by the Society. The Secretary then read, for the information of the Society, the Annual Reports of the Secretary and Treasurer made to the Board of Directors.

MICHIGAN ENGINEERING SOCIETY, SECRETARY'S REPORT.

Sept. 15, 1897.

To the Board of Directors of the Michigan Engineering Society:

I would respectfully report the following business transacted by me for the society since my last report. Immediately after the Annual Convention I let the job of printing the Annuals to the Robert Smith Printing Co., of Lansing, with the understanding that they were to be out in May. I then proceeded to secure what advertising I could while the printers

were at work on the main body of the Annual. After sending out a great number of letters with meager results, I appealed to the members by circular letter for assistance. Messrs. Riggs, Sears, Rogers, Appleton, and Wells responded with valuable assistance. Nothing was heard from other members except from one, who refused to do anything, on the ground that he could not do it with a clear conscience. If it is indeed wrong to solicit advertising patronage, and favor those who favor us, the sooner we quit putting advertisements in the Annual the better. If it *is* wrong, the secretary has a grievous lot of sins to answer for. He has not only secured the bulk of the advertising for the past ten years, but he has given the advertisers his patronage whenever he had any to give, and sent business their way whenever he could. The advertising patronage this year was much less than last, and members have been less prompt in paying their dues. The Annual was got up less expensively than last year, and 300 more copies were printed to supply our increasing exchange list, making 1,800 in all. There has been a net reduction in the expenses of the society from last year of $142; but the shortage of $172.88 on advertising and $90 in dues from members, has left the finances in a less favorable condition than a year ago.

During the year, certainly two and probably four exchanges have been added to our list. I have sent out 1,510 copies of our 1897 Annual to societies with whom we exchange reports, and may send 100 more to two other societies. This increased circulation gives increased value to the Annual as an advertising medium. To increase further its value to advertisers, reading-matter was printed opposite each page of the advertisements. This was done with the approval of the officers of the society and of several of the members. One member, however, criticized it as being unjust to some of the advertisers. As no special page rates were made for any but cover pages, I am unable to see that the criticism was either fair or just.

Ballots for new members were sent out in March, and all were elected as announced in the Annual. I have not received the membership fees from Messrs. Barrally and Snow, and

their memberships are forfeited unless the directors see fit to extend the time for payment as provided by By-Law 3.

A. Barthel and Seth Dean have applied for withdrawal. The dues of the former are paid in full, and he is entitled to an honorable discharge. The latter applied for withdrawal just after the 1897 dues became payable, and asks that they be remitted. He is the secretary of the Iowa society, gets our reports by exchange, and is too far away to attend our meetings.

Henry Melchers, A. L. Marhoff, F. S. Dewey, and L. M. Davis, are more than two years in arrears for dues. All of them have been notified as required by By-Law 6, and no response has been received. Their memberships should be annulled. No attempt has ever been made by the society to collect back dues from parties who have forfeited their membership. If the society chooses to collect these dues and the parties are responsible, no doubt it can be done.

Ballots for officers were sent out August 15, and such as have been returned are herewith presented for canvassing. It is to be regretted that so many of our members do not attend our conventions and get acquainted with each other, and that so many fail to vote for officers.

The secretary has on hand a large number of the reprints of Messrs. Hazen & Williams' papers, for which there has been no call the past year. Exchange reports have been received from Connecticut, Iowa, Illinois, and from the universities of Michigan, Illinois, and Minnesota. A box of reports from the school of Practical Science, of Toronto, lies in the express office at Climax, awaiting an adjustment of the charges, which were so excessive that I refused to take the books. The other exchanges to be received are from the Ontario, Ohio, Indiana, and Minnesota State societies, and the association of the South, also from Purdue University and the University of Tennessee, though it may be that the latter will not publish a magazine this year. Arrangements are partly made for an exchange with the *Transit*, of the University of Iowa, and with the Wisconsin State society, a small new society just starting out, with their first report this year.

F. Hodgman, *Sec.*

MICHIGAN ENGINEERING SOCIETY TREASURER'S REPORT.

SEPT. 15, 1897.

THE BOARD OF DIRECTORS: I would report the following received and disbursed by me for the society during the past fiscal year: —

RECEIPTS.

Cash on hand at the beginning of the year	$179 00	
Received from membership fees	53 00	
" for annual dues	250 75	
" from advertisers	250 50	
" from sales of reports	30 50	
		$763 75

DISBURSEMENTS.

Paid Secretary as voted by the society	$175 00	
" for Annuals and miscellaneous printing	444 11	
" for postage and envelopes	37 20	
" expenses of Board of Directors	29 26	
" freight and express	11 39	
" miscellaneous expenses, including music	18 56	
Cash on hand Sept. 14, 1897	48 23	
		$763 75

The Society owes the Smith Printing Co. $119.63. There are no other debts.

There is due the society from advertisers	$ 59 00
" " " members' one year dues	111 00
" " " from sales of Annuals	26 50
" " " members' two or more years' dues	108 00
" " " from dropped members	152 00

F. HODGMAN, *Treas.*

Subscribed and sworn to before me this 14th day of September, A. D. 1897.

WILBUR C. POND,
Notary Public for Kalamazoo County, Mich.

On motion of Mr. Wells, it was voted to appoint a committee of three to report to-morrow morning upon a plan for conducting our advertising canvassing, and make such general recommendations regarding the finances of the society as they may see fit, for the action of the society. Messrs. H. E.

Riggs, J. B. Davis, and Geo. L. Wells were appointed such committee, which in due time made the following report: —

Your committee appointed to consider the matter of advertising, and the financial condition of the society, begs leave to report as follows : —

The success of this society depends upon the maintenance of the membership and the publication of all our most valuable papers.

In order to make our Annual a success, we must secure enough advertising patronage to pay for the expense of publishing.

We recommend the appointment of a committee of three or five members to solicit advertising.

We recommend that they divide the work, and that each member take certain lines of business.

Now is the time to secure advertisements, before the contracts for the new year are closed, and we would urge this committee to be prompt in their action.

We would urge every member of the society to make an effort to secure additional members. We need to increase our active working membership either by adding new names or rousing up present members who are inactive.

We would recommend making a thorough canvass of the State with the object of securing the name and address of every surveyor and civil engineer residing in the State.

We would advise making a strenuous effort to secure the attendance of as many as possible of those who are not members, and of all our members, at our 20th annual meeting next year.

We would further recommend that the secretary compile a circular, setting forth the actual cash value, to each member of the society, of the publications which our membership gives.

This society is financially in debt. We must get it out, and leave a balance in the treasury. Only hard work will do this.

We recommend that our secretary be paid the same compensation as last year, and we would commend his loyal and

faithful work for the society, — work which the few dollars paid him is wholly inadequate to measure.

H. E. Riggs,
J. B. Davis,
Geo. L. Wells.

Mr. Riggs: Now in addition I wish to say for myself that this society has been a great deal of benefit to me, not only in meeting the other engineers and extending my acquaintance, but in a financial way. I am indebted to several members of this society for various pieces of work, and within the past month I received a letter from a gentleman I never heard of before, out in Iowa, and the opening paragraph says: "Having had my attention called to a discussion in the Michigan Engineering Society Report, I take the liberty, —" etc. The result was the securing of a piece of work that will not only pay all dues and expenses of the society I have paid in, but all I will pay in the next ten years. I believe that we ought to bring in more men, and interest them in our society. The society has a reputation in the State of Ohio second to none in the Union. There is only one way to make it a financial success, and that is for every member to put his shoulder to the wheel, and push.

The report of the committee was adopted, and in compliance therewith a committee of five, consisting of Messrs. H. E. Riggs, Geo. L. Wells, F. B. Slocum, M. Walker, and B. E. Parks, was appointed to secure advertising for the Annual. The secretary was voted $175 for his services the past year.

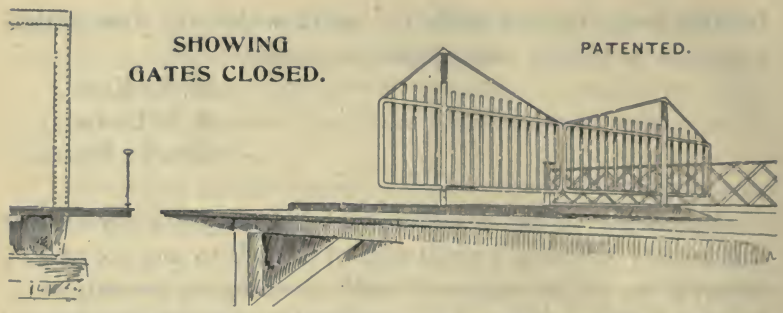
The following persons were nominated for officers for the ensuing year: —

For President, Frank F. Rogers, of Port Huron; Prof. C. E. Greene, of Ann Arbor.

For Vice-President, J. J. Hubbell, of Manistee.

For Secretary-Treasurer, F. Hodgman, of Climax.

For Directors, Prof. J. B. Davis, of Ann Arbor; Wm. B. Sears, of Saginaw; Dorr Skeels, of Grand Rapids; H. E. Riggs, of Toledo; G. S. Williams, of Detroit.



Loss of Life, Heavy Damages, and Expensive Litigation

May be avoided by properly protecting the approaches of swing bridges, by the use of **THE HURON AUTOMATIC BRIDGE GATES.** Operated automatically, or from the center of the bridge, by the bridge tender.

Correspondence solicited.

MANUFACTURED BY

DRY DOCK IRON WORKS,
PORT HURON, MICH.

Sandusky Portland Cement.

MEDUSA BRAND.

SANDUSKY PORTLAND CEMENT CO. MEDUSA BRAND TRADE MARK SANDUSKY, OHIO.

Guaranteed equal to best imported.

Unsurpassed in fineness, strength, and durability.

Over 100,000 barrels furnished for large government and private contracts during 1897.

Production: 600 barrels per day.

It was voted that a committee of five be appointed to prepare for the twentieth annual convention, the present president to be chairman. The committee was appointed as follows:—

Frank F. Rogers, Geo. L. Wells, H. E. Riggs, E. W. Muenscher, and G. S. Williams.

The thanks of the society were voted to Mr. Ryan for his paper, and to the Street Railway and Tunnel companies for courtesies extended the society.

Mr. Skeels: On the town line of township six north range seven west, our government field notes show that Deputy United States Surveyor Clark commenced across Grand River, and surveyed for so many chains and links to a certain oak tree, and laid down and died — died with his boots on. Now I think it would be good policy for this society to locate that oak tree again, and erect a suitable monument. I think the tree is not standing now; but it could be located.

Mr. Wells: I move that a committee be appointed to locate the spot, and raise funds for a monument, and report a year hence.

Motion was seconded by Mr. Albertson, and carried.

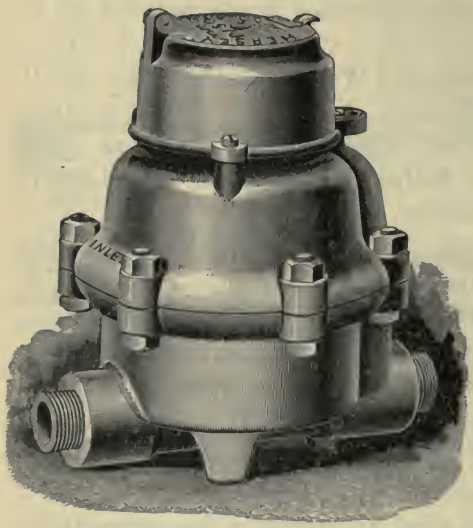
President: I will appoint Mr. Skeels, George Ames, and Mr. Rumsey.

Mr. Hodgman: This card was sent to me by one of the charter members of our society, one whom I hope to see put into the ranks of the Honorary Members before it is too late: —

"Byron: Please give this letter to Mr. Hodgman. Say good-by to the boys for me, as my work is about done, as with only one eye, one hand, and one leg, a man can't do much. H. C. P."

Professor Davis: I move that the name of H. C. Pearsons be made the first name on the roll of Honorary Members of this society, there to remain during the life of the society, and that no other name be added to that roll for a period of three years, except under circumstances similar to that under which we find

HERSEY, DISC, TORRENT.



Three First-Class

Water Meters.

SIMPLE,
ACCURATE,
AND DURABLE.

Send for Catalogue and Prices.

Hersey Manufacturing Company.

Factory and Main Office, South Boston, Mass.

THE

MASSILLON BRIDGE CO.,

General Office and Works, MASSILLON, O.

Iron, Steel, and Combination Railroad and Highway Bridges, and Structural Iron Work.

For Plans and Estimates, address,

THE MASSILLON BRIDGE CO., Toledo, Ohio.

When answering advertisements, please mention "Michigan Engineers' Annual."

our brother placed, referring to the honorary members from our own lists.

Motion seconded by Mr. Skeels. Carried.

Professor Davis: I move that the brotherly regard of this society be transmitted, as far as words can do it, to our Brother H. C. Pearsons, and further move that a committee be appointed by the Chair to prepare a testimonial of regard, for the purpose of giving expression to this motion.

Motion seconded by Mr. Appleton. Carried. Chair appointed Professor Davis, Mr. Hodgman, and Col. Muenscher such committee. The committee prepared the testimonial, which was approved by the society, and forwarded to Mr. Pearsons by the secretary.

Mr. Riggs: Our committee on the relation of water-supply to the public health has no report to make. It seems to me that now is as appropriate a time as any to say a few words. A year ago the committee recommended action by the society looking toward the necessity of the approval of the Michigan Board of Health to the disposition of sewage or plans for water-works. Within the last month the State Medical Society has taken similar action. I believe that it will be a great benefit to the people of the State and a great benefit to the engineering profession to have some such action. The State of Ohio is in the same shape as the State of Michigan. The board of health is hampered, they have not the authority they ought to have or the money they ought to have to carry on the work; but they have a wide-awake president and secretary, and if any one attempts to prepare plans for sewerage and water-works in Ohio, and undertakes to put them in contrary to that board, I think it is safe to say he will get into trouble. I believe that the board of health is the proper place to put it. A board of public works, or other political board, would not be as safe as the board of health, which is made up of professional men. I believe that this society ought to keep this matter of the approval of the State Board of Health moving. It may be several years before we can get the passage of any such law as we would like to have; but we want to keep the thing stirred

MEACHAM & WRIGHT,

Manufacturers' Agents for

UTICA HYDRAULIC CEMENT

And Dealers in

Imported and American Portland Cement, Michigan and New York Stucco.

Telephone, Exp. 59. 98 Market St., Chicago.

L. BECKMANN,

Manufacturer of

IMPROVED SURVEYING AND ENGINEERING INSTRUMENTS.

Best workmanship and lowest prices.
Maker of the celebrated Hodgman Tape.

319 ADAMS ST.,
TOLEDO, OHIO.

"The Wandering Singer and His Songs,"

By F. HODGMAN.

A BOOK OF COLLEGE AND OTHER POEMS.

185 pages, printed on excellent paper, with full gilt edges, and bound in pebbled white cloth, with blue and gilt trimmings. It is beautifully illustrated with half-tones of college and other scenes.

The following are samples of a great number of voluntary testimonials which the author has received: —

Prof. J. B. Davis, of the University of Michigan, writes: —

Your little gem of a book came last evening. You have done beautifully, besides adding to our lives a beam of that light which never fades entirely away. Please send me five more.

Prof. E. Davenport, of the University of Illinois, writes: —

I enclose $1 to pay for paper, ink, and binding of "The Wandering Singer and His Songs." For all that is more than these, for the old-time memories it arouses, for all that is chaste and elevating, and for all that makes the book a treasure, I am still, and must remain, your debtor.

Price, $1. If ordered by mail, add 6 cts. for postage.

Published and for sale by the author, F. HODGMAN, Climax, Mich.

When answering advertisements, please mention "Michigan Engineers' Annual."

up. I don't believe there is a question any more vital in interest to the State than the securing of a proper water-supply, and the disposition of the sewage of cities.

Col. Muenscher: I have followed this subject with a great deal of interest. I move that the committee on the Relation of Water-supply to Public Health be continued during the coming year, and requested to prepare a memorial, to be submitted in the name of this society to the next session of the legislature. It may be well to ask the co-operation of the medical societies and the board of health and such other societies as would be likely to be interested, for instance, the Detroit Engineering Society.

Motion seconded by Professor Davis. Carried.

Mr. Wells: I think the motion should make plain the invitation for the co-operation of the other societies.

Col. Muenscher: I will accept that as a modification, that the secretary be instructed to invite the co-operation of these bodies with us in this action.

President: The motion is that the present committee be continued, and instructed to prepare a memorial to the next legislature, and to secure the co-operation of similar societies, the Detroit Engineering Society, and the medical societies of the State, in securing legislation.

Motion carried.

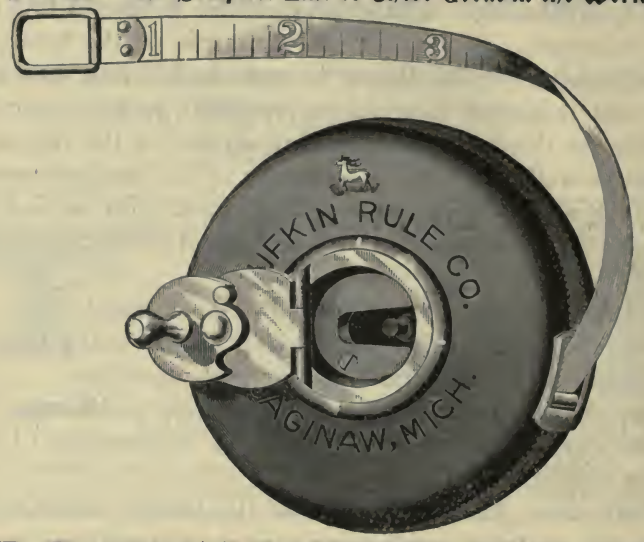
The society then proceeded to the special order of the evening, the social meeting, which was enlivened by music from a local club, and toasts and responses by the members. Mrs. Parks, a daughter of our honored member, H. C. Pearsons, also favored the society by playing many familiar and favorite melodies on the piano, and all who chose joined in the singing.

A special meeting of the Board of Directors was held December 30.

The applications of Owen Morris, Wm. G. Clark, W. J. Sherman, O. L. E. Weber, and S. G. Jenks were approved for Senior Membership, and that of Wm. R. Ryan was approved for Junior Membership. H. C. Pearsons, member of the society, was nominated by the Board for Honorary Membership.

Measuring Tapes

Best Most and Complete Line of These Goods in the World.

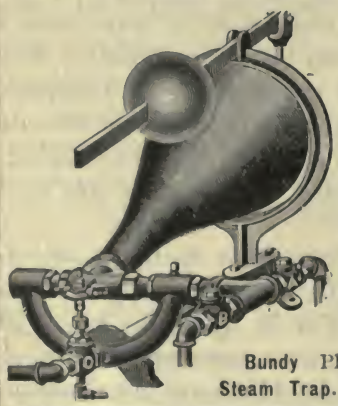


OUR CELEBRATED RELIABLE STEEL TAPE

Paine Pattern, Frame, Rival and Pocket Steel Tapes. Metallic Warp, and Linen Tapes, Steel Rules, Etc. Our name on steel tape is a guarantee as to its accuracy and reliability. Send for Catalogue.

LUFKIN RULE CO. - - Saginaw, Mich.

"Sure Cure for Steam, Water, and Fuel Wastage."



Bundy TRADE MARK

Steam Traps. Feed Water Heaters.
Gravity Pumps. Safety Water Columns.
Exhaust Heads. Steam and Oil Separators.

A. A. GRIFFING IRON CO.

66-68 CENTRE ST., NEW YORK

Bundy Steam Trap. Philadelphia, Boston, Jersey City, N. J.

Book M E Free on "Power Economy."

Allen Hazen, of Boston, Mass., and Prof. R. C. Carpenter, of Ithica, N. Y., non-members, were also nominated for Honorary Membership. The applications of Frank P. Mills and V. Sebring Hillyer for withdrawal were granted. At a later date the applications of A. L. Holmes, of Grand Rapids, and John Elsmere, of Battle Creek, were submitted by letter to the Board of Directors, and they were approved for Senior Membership. All the above persons were duly elected members by letter ballot submitted March 7, 1898.

F. Hodgman, *Sec.*

MANUAL OF LAND SURVEYING.

By F. Hodgman, M. S. C. E., Practical Surveyor and Civil Engineer. 524 pages, printed on strong, light paper, and bound in morocco, with flap.

THE LAND SURVEYOR'S BEST POCKET COMPANION.

Read This Price, $2.50.

Department of the Interior,
General Land Office.
WASHINGTON, D. C., March 10, 1895.

MR. F. HODGMAN, Climax, Mich.

DEAR SIR: In my work at the office I have to write replies to County Surveyors' inquiries upon all sorts of cases. I was much pleased to receive a copy of the new edition of your work on Surveying. I find daily occasion to refer to it at my desk, and have given it many a strong commendation to others. It has been shown to the six or eight gentlemen forming this division with my unqualified opinion that *it is the most intelligent and complete summary of all that a practical surveyor should know or should have in his pocket for ready use, of all the books I have seen.* The directions regarding work on old lines and identifying old corners are not equaled elsewhere. Major Shinn was glad to see how copiously you had used the latest features of the new manual that he compiled and revised, even his ingenious table at the last of your book. With many thanks for the book, I am,

Yours truly,

A. W. BARBER.

SURVEYORS' TABLES.

132 Pages. Being the Tables from the Manual of Land Surveying, bound separately. Price, $1.

The Star Edition of these tables is put up with the best possible paper, binding and workmanship to be had in the market. It is an exceedingly handy and valuable Pocket Table Book for the use of Students, Surveyors, Civil and Mining Engineers. Price, $1.50.

Field Book for Surveyors.

Specially Adapted to Michigan County Surveyors' Records.

176 blank pages, ruled in small cross sections, and 20 pages of tables of Natural Sines, Tangents, Secants, Departures, Azimuths of Polaris, Radii and Deflections, Tangents and External Secants of 1° Curve, Curve Formulæ and Traverse Table. Well bound in flexible leather with flap and pencil holder.

Single copies, by mail, 75 cents, per dozen, by express, $7.

The above books published and for sale by F. HODGMAN,

Secretary Michigan Eng. Society,

CLIMAX, MICH.

When answering advertisements, please mention "Michigan Engineers' Annual."

MICHIGAN ENGINEERING SOCIETY, LIST OF MEMBERS, 1898.

HONORARY MEMBERS.

Pearsons, H. C., Ferrysburg, Mich.
Carpenter, R. C., Ithaca, N. Y.
Hazen, Allen, St. Paul Bldg., New York.

SENIOR MEMBERS.

Albertson, Dan J., Surv., Kalamazoo, Mich.
Appleton, William, C. E., Lansing, Mich.
Ames, Geo. M., City Eng., Grand Rapids, Mich.
Bailey, M. H., Surv. and Civ. Eng., Dimondale, Mich.
Barrington, Edward, Civ. Eng., Chihuahua, Mexico.
Barrally, T. W., Civ. Eng., N. Tonawanda, N. Y.
Bean, Henry F., Civ. Eng., Jackson, Mich.
Beckmann, L., Mfr. Surv. Instruments, Toledo, O.
Beden, Seth N., Surv. and Civ. Eng., Clio, Mich.
Bement, Clarence E., Mfr., Lansing, Mich.
Blair, James, City and County Surv., Adrian, Mich.
Bradt, J. C., Surv., Marcellus, Cass Co., Mich.
Bradt, E. F., Mining Eng. and Chemist, P. & L. A. Iron Co., Ispheming, Mich.
Bristol, Geo. F., Asst. Eng., D. G. R. & W. R. R., Grand Rapids, Mich.
Brotherton, D. A., Civ. Eng., Salt Lake City, Utah.
Brown, F. H., Surv., Sault Ste. Marie, Mich.
Brown, Geo. M., Superintendent of Roadway and Structures, F. & P. M. Ry., Saginaw, E. S., Mich.
Callard, J. L., Civ. Eng., Sault Ste. Marie, Mich.
Campau, Thomas, Surv., Detroit, Mich.
Carpenter, L. G., Prof. Eng., State Agricultural College, Fort Collins, Colo.
Cavis, C. H. V., Consulting Eng. D. S. S. & A. Ry., Marquette, Mich.

Do You Want a

WATER TUBE BOILER

Absolutely Safe?
Using no Cast Iron in Construction?
The Most Accessible and Durable?
The Easiest to Clean and Repair?
Very Economical in Fuel?
Sold at Small Profit?

IT IS

THE WICKES WATER TUBE SAFETY STEAM BOILER,

MANUFACTURED BY

WICKES BROS., Saginaw, E. S., Mich.

GEO. M. EDDY & CO.,

Manufacturers of

MEASURING TAPES.

Cotton, Linen, and Steel

Tapes of all kinds for engineering purposes, guaranteed U. S. standard. Band Steel Tapes, one-eighth inch wide, graduated as desired, in feet or every ten feet; will not kink or break. We desire to call attention to our new flush handle and method of winding for steel tape cases, which is universally approved. Send for price.

345 TO 353 CLASSON AVE., BROOKLYN, N. Y.

When answering advertisements, please mention "Michigan Engineers' Annual."

Clark, Wm. G., Chief Eng., American Sanitary Eng. Company, 2,024 Smead Place, Toledo, O.

Courtright, P. A., Marshall, Mich.

Cooley, M. E., Prof. Mech. Eng., U. of M., Ann Arbor, Mich.

Cummings, Geo. P., Surv. and Civ. Eng., Marquette, Mich.

Cummings, Chas., Surv. and Civ. Eng., Marquette, Mich.

Davis, J. B., Asst. Prof. Civ. Eng., U. of M., Ann Arbor, Mich.

Dennis, E., Mech. Eng. and Mfr., Jackson, Mich.

Denison, Chas. S., U. of M., Ann Arbor, Mich.

Doane, Geo. W., Surv., Gladwin, Mich.

Douglass, Benj., Bridge Eng., M. C. R. R., Detroit, Mich.

Dunbar, E. L., Chief Eng. and Supt. of Water Works, Bay City, Mich.

Eaton, Albert, Lodi, Cal.

Elder, Wm. D., Asst. City Eng., Kalamazoo, Mich.

Elsmere, John, Civ. Eng., Battle Creek, Mich.

Fargo, Wm. G., Surv. and Civ. Eng., Jackson, Mich.

French, E., Civ. Eng., G. T. Ry., Detroit, Mich.

Gardner, Albro, Civ. Eng., Seattle, Wash.

Goodale, O. C., Surv., Cheyenne, Wy.

Granville, John J., Saginaw, E. S., Mich.

Greene, Charles E., Prof. Civ. Eng., U. of M., Consulting Eng., Ann Arbor, Mich.

Harris, J. W., Civ. Eng., Cont. and Mfr., Baraboo, Wis.

Harrod, J. W., Surv., Ithaca, Mich.

Hayes, Eli L., Surv. and Map Pub., Buffalo City, Ark.

Hawley, R. W., Albuquerque, N. M.

Hemingway, L., Surv. and Civ. Eng., Benton Harbor, Mich.

Hendrick, C. E., Min. Eng., Lake Superior Iron Co., 424 S. Pine St., Ishpeming, Mich.

Hodgman, F., Author and Publisher, Climax, Mich.

Holmes, Charles, 501 S. Park St., Saginaw, Mich.

Holmes, Alba L., Grand Rapids, Mich.

THE ENGINEERING RECORD

GIVES PROMINENCE TO

MUNICIPAL ENGINEERING.

Construction and Operation of Water-works, Sewers and Sewage Disposal Plants, Roads and Pavements, Garbage Disposal.

GENERAL CIVIL ENGINEERING.

Docks, River and Harbor Improvements, Subways, Canals, Contractor's Plant.

STRUCTURAL ENGINEERING.

Bridges and Buildings, Ventilation, Heating, Elevator Service, Lighting, Plumbing.

STEAM ENGINEERING.

Design, Construction and Management of Power Plants.

Published EVERY SATURDAY, at 100 WILLIAM STREET, NEW YORK.
$5.00 per year; Single Copies, 12 Cents.

THE ENGINEERING RECORD is the recognized medium for advertisements inviting proposals for all Municipal and U. S. Government Engineering and Public Building Work. Its subscribers include the experienced and reliable Contractors and Manufacturers of Engineering and Building Supplies in all sections of the United States and Canada. The RECORD'S value to secure competition in bids is therefore obvious.

To Our Patrons.

WE ASK for our advertisers the support and patronage of all our readers.

THEY ARE all first-class, reliable firms, many of whom are well and favorably known the world over.

AS A CONSIDERABLE PORTION OF THE EXPENSE of publishing the "Annual" is paid from the advertising, we expect every member of the Michigan Engineering Society will, when other things are equal, favor those who favor us with their patronage, and use his influence to send orders their way.

When answering advertisements, please mention "Michigan Engineers' Annual."

Hubbell, J. J., Chief Eng. M. & N. E. R. R., Manistee, Mich.

Hunt, E. U., Civ. Eng., Battle Creek, Mich.

Jarvis, Samuel E., Mech. Eng., Lansing, Mich.

Jenks, S. G., Mech. Eng., Port Huron, Mich.

Jopling, Jas. E., Civ. and Min. Eng., Marquette, Mich.

June, L. W., Surv. and City Eng., Big Rapids, Mich.

Kirby, Frank E., Eng., Detroit, Mich.

La Rue, Benj. F., Prin. of School of Civ. Eng., International Correspondence Schools, Scranton, Pa.

Mark, Geo. A., Surv., Hillsdale, Mich.

Martin, Geo. F., City Eng., St. Joseph, Mich.

Masson, Geo., Civ. Eng., Detroit, Mich.

Mason, Carlisle, M. E., Butte, Mont.

Mc Leod, D. A., Civ. and Cont. Eng., Manistee, Mich.

Mc Vean, J. J., Chief Eng. D. G. R. & W. Ry., Grand Rapids, Mich.

Mc Cormick, R. S., G. T. Ry., Detroit, Mich.

Mitchell, C. E., Civ. Eng. and Cont., Ludington, Mich.

Mitchell, J. A., Civ. Eng. and Cont., Ludington, Mich.

Meighan, John F., Surv. and Civ. Eng., South Bend, Ind.

Morley, Fred, Prof. of Civ. Eng., Purdue Univ., La Fayette, Ind.

Morris, Owen, Estate of W. Vanderbilt, Esq., Hyde Park (on the Hudson), N. Y.

Muehle, B. H., U. S. Asst. Eng., 41 Telephone Bldg., Detroit, Mich.

Muenscher, Emory W., City Eng., Manistee, Mich.

Mullett, John H., Surv., Williamston, Mich.

Nellist, John F., Surv. and Civ. Eng., Grand Rapids, Mich.

Newell, V. V., Mech. Eng., Brooklyn, N. Y.

Pashby, C. C., Civ. Eng., Sherard, Miss.

Parks, Byron E., Ferrysburg, Mich.

Pettee, William H., U. of M., Ann Arbor, Mich.

Pierson, Geo. S., Civ. Eng. and Cont., Kalamazoo, Mich.

Porter, H. H., Hydraulic Eng., Dowagiac, Mich.

James H. Rand

BANKER,

Dealer in Municipal Bonds.

North Tonawanda, N. Y.

Transits and Levels for Sale

At about one-half manufacturers' prices.

A large variety of instruments; many absolutely as good as new. Engineering Instruments wanted.

If you desire either to buy or sell, write us.

ENGINEERS' INSTRUMENT EXCHANGE, Scranton, Pa.

Buckeye Portland Cement Co.,

BELLEFONTAINE, OHIO,

MANUFACTURERS OF

BUCKEYE PORTLAND CEMENT

The Purest, Strongest, and Most Durable Portland Cement made. Engineers' and experts' tests, continued during the last twelve years, show its superiority over other brands.

A pamphlet entitled "**How to Use Portland Cement,**" and full information concerning this Cement, sent on application.

WATER WHEELS

ADAPTED TO ALL HEADS FROM

3 FEET to 2000 FEET.

Our experience of ***36 years*** building water wheels enables us to suit every requirement of water power plants. We guarantee satisfaction. Send for pamphlet of either wheel and state your ***head*** and full particulars.

AUTOMATIC STEAM ENGINES

WITH SUITABLE BOILERS. Built in latest style, of best design and ***highest excellence.*** Sizes from 3 horse-power upwards. Send for Engine Pamphlet D.

JAMES LEFFEL & CO., Springfield, Ohio, U.S.A.

When answering advertisements, please mention "Michigan Engineers' Annual."

Randall, John, Civ. Eng., Deadwood, S. Dak.

Reed, S. S., Surv., Three Rivers, Mich.

Reed, A. L., Gen. Mgr., East Whittier Land & Water Co., Whittier, Los Angles Co., Cal.

Redman, C. H., Asst. to City Eng., Grand Rapids, Mich.

Riggs, H. E., Civ. Eng., Toledo, O.

Ripley, Joseph, U. S. Asst. Eng. and Gen. Supt., St. Mary's Falls Canal, Sault Ste. Marie, Mich.

Rogers, Frank F., Civ. Eng., Port Huron, Mich.

Root, O. J., Mech. Eng., Watertown, N. Y.

Rothwell, H. G., Civ. Eng., Laramie, N. Y.

Roberts, R. W., Civ. Eng., Saginaw, E. S., Mich.

Rumsey, Jas. L., Civ. Eng., Grand Rapids, Mich.

Russel, Walter S., Vice-President Russel Wheel and Foundry Co., Detroit, Mich.

Sears, Wm. B., Chief Eng. F. & P. M. Ry., Saginaw, E. S., Mich.

Sellers, Ernest O., Evangelist, Chicago, Ill.

Shenehon, Francis C., U. S. Eng.'s office, Sault Ste. Marie, Mich.

Sheldon, Chas. S., Eng., Office C. & W. M. Ry., Grand Rapids, Mich.

Sherman, W. J., Civ. Eng., 613, The Nasby, Toledo, O.

Skeels, Dorr, Surv. and Civ. Eng., Grand Rapids, Mich.

Skeels, F. E., Agricultural College, Mich.

Slocum, F. B., Sales Mgr. for H. R. Worthington, Detroit, Mich.

Smith, R. C., Asst. Eng., F. and P. M. R. R., Saginaw, E. S., Mich.

Snow, Jas. B., C. E., Tonawanda, N. Y.

Steele, Geo. E., Fernando, Cal.

Strong, E., Kalamazoo, Mich.

Taft, M. C., City Eng., Kalamazoo, Mich.

Taylor, Clarence G., U. of M., Ann Arbor, Mich.

Terry, H. E., City Eng., Saginaw, E. S., Mich.

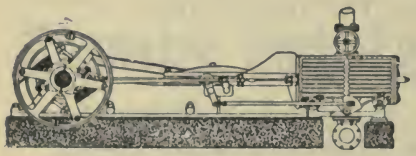
Teed, Augustus J., City Eng., Cadillac, Mich.

Thayer, H. L., Civ. Eng., Lansing, Mich.

The Arbuckle-Ryan Co.

TOLEDO, OHIO,

Manufacturers' Agents and General Contractors of



STEAM MACHINERY.

Simple Cylinder, Medium Speed, 4-valve Corliss, from 100 to 600 H. P. Compound Cross and Tandem, 150 to 1,500 H. P. High-Speed Simple and Compound Tandem and Cross, 20 to 400 H. P.

Complete Power Plants a Specialty.

When answering advertisements, please mention "Michigan Engineers' Annual."

Thompson, H. C., City Eng., Sault Ste. Marie, Mich.

Tittman, Ferd., Civ. Eng,—— Austria.

Todd, O. H., County Surv. and Drain Com., Fairfax Sta., Mich.

Treadwell, E., Civ. Eng., Saginaw, E. S., Mich.

Tuthill, Job, Eng. of Bridges, C. & W. M. Ry., and D. G. R. & W. Ry., Grand Rapids, Mich.

Vedder, H. K., Agricultural College, Mich.

Vincent, Wm., Manistee, Mich.

Walker, M., Mfr. and Cont., Water Works, Fenton, Mich.

Watkins, John J., Civ. Eng. and Surv., Guthrie, Okla.

Wallace, W. H., Supt. S. T. & H. R. R., Saginaw, E. S., Mich.

Weber, O. L. E., Mech. Eng., Port Huron, Mich.

Weil, Charles L., Agricultural College, Mich.

Westcott, A. L., Agricultural College, Mich.

Wells, Geo. L., Eng. and Cont. Agent, The Michigan Pipe Co., 414 Birney St., Bay City, Mich.

Wells, M. N., Res. Eng., A. T. & S. F. Ry., Chanute, Kan.

Wheeler, E. S., Civ. Eng., Sault Ste. Marie, Mich.

Whitney, Harlan K., Dept. Co. Surv., Battle Creek, Mich.

Whitten, Wm. M., Surv. and Civ. Eng., 125 N. Lafayette St., South Bend, Ind.

Williams, G. S., Civ. Eng., Water Works Dept., Detroit, Mich.

Williams, T. O., Co. Surv., Grand Rapids, Mich.

JUNIOR MEMBERS.

Bush, P. R., Civ. Eng. and Surv., Neptune, La.

Calkins, A. S., Asst. City Eng., Joliet, Ill.

Ryan, Wm. R., Asst. City Eng., Port Huron, Mich.

MICHIGAN ENGINEERS' ANNUAL.

This Annual publication is the organ of the Michigan Engineering Society, and contains the papers read before the Society and the discussions thereon.

THESE ANNUALS contain more than 200 papers on matters of interest to Surveyors and Civil and Mechanical Engineers, written by practical men of experience who know thoroughly what they are writing and talking about. . . . .

Some of the Subjects Treated are

Land Surveys,
Easement Curves,
Photographic Surveying,
Village Plats,
Bridge Work,
Sewerage,
Railway Surveys,
Construction and Maintenance,
Hydrographic Surveying,
Map Drawing,
Water Works,
Drainage Engineering,
Cemetery Surveying — plats and records,
Highway Location and Construction,
Irrigation,
and an Extensive Digest of Legal Decisions of Special Interest to Land Surveyors and Civil Engineers.

* * *

This large amount of valuable matter, constituting an engineering education of itself, can be had in no other place or form. The Society offers these annuals for sale at the following prices:—

For the years 1880, 1881, 1882, and 1884, - - 50c each
For 1885, - - - - - - - - - 75c each
For 1891, 1892, 1893, 1894, 1895, and 1898, - - $1.00 each
For 1896 and 1897, - - - - - - - 1.25 each

For the intermediate years the Society has but very few copies left, and these will only be sold in full sets. Price of the full sets, 1880 to 1898 inclusive, $14.

For sale by

F. HODGMAN, Sec'y Mich. Eng. Society, CLIMAX, MICH.

When answering advertisements, please mention "Michigan Engineers' Annual."

THE COUNTRY-ROAD MAKER.

WM. APPLETON.

Mr. President and Gentlemen: You must be in a humorous mood, to ask me to talk about the country-road maker, at a time when we are bound to pass compliments. We can't scold in such a pleasant state of mind; but, sir, just think of this subject,— how many of this very important officer there is. His name is Legion. He lives everywhere. He has every kind of ability and fitness for the job, from A 1, clipper-built, copper-bottomed, well-rigged, officered, and manned, down to no qualification at all. I drove along a suburban road in the spring, on a leading thoroughfare, that the adjoining city had donated $300 to buy gravel for. Much labor had been spent on that road,— even to a surveyor, who worked some days to locate the center for gravel,— all having good results, but it needed repairs in places. In a low, wet spot by the roadside, with a good team plowing, and getting ready to scrape that sponge on the roadbed, there he was, two of him, good farmers' sons, graduates of the high school, they had been clerks in the city, and were "on to their job."

"Halloo, boys, that is n't good road material is it?" "Well, it is what we have got." I found he was as full of knowledge as an empty oyster can of turtle soup. He knew it all, or thought he knew, which was not quite the same thing; but he was working hard, and did put a coat of muck on that roadbed. After all, he was only an average highway builder, not equal to Mc Adam, of whom he knew nothing. God bless him, he did but little harm. The sun soon dried the muck to dust, and the wind blew the dust over the fence. It is gone to the crops that need it.

I found two other road-makers a few miles from there. One of them was an observing cuss. He had seen clay put on

The Engineering and Mining Journal.

Absolutely Indispensable to the Prospector, Miner, Chemist, Engineer, Metallurgist, Manufacturer, Banker, Investor, and Legislator.

The Engineering and Mining Journal is, in short, the most useful, progressive, widely circulated, and influential paper in the world, devoted to the mineral industry, and no one engaged in any department of that industry can afford to be without it. For the United States, Mexico, and Canada, subscription price, $5 per annum; for all other countries in the postal union, $7.

The Engineering and Mining Journal,
253 Broadway, New York.

Stone...

An Illustrated Magazine, Subscription rates: Year, $2, Six Months, $1.25, Sample Copies, 25 cents. The best advertising medium. Exclusively a paid circulation.

The Standard Periodical . . .
of the Stone, Marble, Granite, and Slate Trades.

D. H. Ranck Pub. Co.
---Publishers.---

Main Office, Pontiac Building, 358 Dearborn St., Chicago.

American Engineer, Car-Builder, and Railroad Journal

An Illustrated Monthly devoted to Mechanical Engineering and Railroad Topics.

Subscription Price, $2 a year. **Established 1832.**

R. M. VAN ARSDALE, Prop.,
140 Nassau St., New York City.

The RAILWAY REVIEW.

Office of Publication, The Rookery, Chicago.
Eastern Office, 189 Broadway, New York.

Terms of subscription, per year, $4; foreign subscription (including postage), $5. Convenient binders sent post-paid for $1. All remittances should be by draft, express, or money-order, payable to THE RAILWAY REVIEW. Address all communications to

THE RAILWAY REVIEW, Rookery, Chicago.

When answering advertisements, please mention "Michigan Engineers' Annual."

sand, and work well, so he posts off to the adjoining district about thusly: "Jim, I would like to make that sand-hill passable. Let us put all our teams at work together, get shovelers, and draw clay from the mud-flat to the hill, and load back with sand. By working both ways, we will get a fair road in both districts." Jim agreed to the scheme, and they worked with a will, and so improved the sand-hill and mud-flat that it became a good driving road, and all with one year's statute labor. This was another type of the country-road maker. If you should approve this, and say they used the best they had, heed the sequel: Jim was killed by railroad cars, and Ed moved away, while the muck-hauler is on deck ready for biz. Good common-sense did n't stay long in office in that neck of woods. I don't like to bore you; but these are actual occurrences, and I wanted to illustrate that even with our defective system, our roads can be, and are being, made better, and if we could keep the public roads in charge of the Eds and the Jims, we could get along. Let us ever bear in mind that if we had the most perfect system, and ample power to procure gravel, provide drainage, and all else necessary for good roads, we would be liable at any time to have some Bill or John draw muck on the roadbed, or show off some other brilliant accomplishment.

Please bear with me. I will just take a minute, if you will permit me, to give a little of my experience with the good-roads movement. Artemus Ward, in speaking of one of his highly moral shows, when he was ridden out of town on a rail, said it was a very amusing spectacle, but he did n't enjoy it. Neither did I my league career. A few earnest men, of more or less skill as road builders, joined by other lovers of good highways, met in the State Capitol at Lansing, and organized a State league, with Wm. L. Webber as chairman and Mr. Hopkins as secretary. Just after this enterprise was launched into existence, each of the political parties started their usual picnics, and began to array every fellow against every other fellow. The people had got well along in lunacy, and they were so hypnotized about silver and gold that it was pitiful

THIS PICTURE Of the parlor of the Harrington Hotel, Port Huron, was taken by F. Hodgman, with an Adlake Camera, at the 18th Annual Convention of the Michigan Engineering Society held at the Harrington, Dec. 28-30, 1897.

The Adlake Camera.

It is a perfect instrument for taking interior views, home portraits, and family groups.

THE ADLAKE has the **finest single achromatic lens that money will buy.** The Shutter is adjustable for time or instantaneous work; is simple and certain in action, and cannot get out of order. The diaphragm has three stops, and there are two View Finders that **find. The ADLAKE** takes 12 pictures on glass plates at one loading. Standard size, 4 x 5. No extras. Get your plates anywhere.

Complete, with 12 Metal Plate-Holders. Prepaid to any part of the United States for $12.

Send your orders for the Camera to

F. HODGMAN, Agent, Climax, Mich.

When answering advertisements, please mention "Michigan Engineers' Annual."

to see them wrangle and speak evil of each other,— "sixteen to one, hurrah! fifty-cent dollars, goldbugs, fools, rascals," etc.,— and when the last vestige of sanity seemed all but gone, the most prominent men in the country were whisked about in special cars, to the time of patriotic music, to misstate facts and pervert truth. These were welcomed by hundreds of people, wearing badges of cardboard, tinseled over by the color of metal the wearer favored, all shouting, the depth and volume of the vociferations being mostly the gage of the value of the job the patriot wanted. This was called popular education. At just about this stage of the craze, when the ordinary civility common to intimate neighbors was neglected until it was known whether they were for sound money or a short dollar, and common-sense was thrown over as a useless incumbrance, poor little I was turned into this seething mass of dazed people, to hold a committee-meeting already named, to draft a wise and careful legislative bill, to supersede the present defective path-master time-honored nuisance. As a precaution I wrote to secretary Hopkins. (No, he had n't), he had been so busy. (No, I need n't get the list of committee), he would get notices printed (adjourn for a short time). This was done, but no printing. After a while I went to see Messrs. Webber and Hopkins. Not to be too tedious, I pass over some weeks, during which Mr. Webber was taken very sick and resigned, having never done anything. The secretary also got out. We now got that bundle of energetic vim, Mr. Peters, to take the place; but we were in a tight place, the time was too short. However, we got a sub-committee to say they would act. All were either in the house or senate. We found everything was subordinated to getting office for one or the other, or as they elegantly termed it, "knifing Ping." So went the winter, talking to members about roads, hearing an occasional word of encouragement; but more often the most impractical nonsense. Friends, I am a stranded and disgusted Roadite. An anecdote of the retreat from Moscow is told: Ney commanded the rear, and when he came to the stream bounding France, he was quite alone and carrying a musket. Challenged

ENGINEERING NEWS

Established 1874.
Published every Thursday.
Subscription Price $5 a Year.

Any engineer who reads "Engineering News" is certain to find in it articles of special interest and value in his particular line of work. He also finds much matter in which he is not so directly concerned. But a general knowledge of what is going on in all branches of engineering practice is most important to every ambitious engineer.

The reading of "Engineering News" gives him just this knowledge.

The Construction News supplement and the proposal advertisements in "Engineering News" are read each week by prominent contractors and manufacturers of contractors' supplies in every part of North America, thus insuring an interest in work reported or advertised in this paper which often results in large savings on contracts.

If you have not seen a recent copy of "Engineering News" kindly send us your name and address on a postal card.

We also publish books on engineering and allied subjects, a complete list of which will be mailed you on request. We have specifications for viaducts and bridges of various kinds, steel roofs, buildings, structural steel, grading and masonry, cross ties, tracklaying, dams and reservoirs, wiring for electric light in buildings, etc. Some of our books are as follows:

Manual of American Water-Works,	Baker,	$3.00
Railway Track and Track-Work,	Tratman,	3.00
Text-Book on Plain Lettering,	Jacoby,	3.00
Engineering Contracts and Specifications,	Johnson,	4.00
Cleaning and Sewerage of Cities,	Baumeister,	2.50
City Roads and Pavements,	Judson,	1.00
Chicago Main Drainage Channel,	Hill,	1.50
Practical Hydraulic Formulæ for Long Pipes	Gould	1.50
Manual of Bridge Drafting,	Wright and Wing	4.00
Tables and Diagrams for Estimates in Sewer Work,	Swaae	.50
Floods of the Mississippi River,	Starling	.50
Stand-Pipe Accidents and Failures,	Pence	1.00
Structural Mechanics.	Greene	3.00
Road Making and Maintenance,	Herschel and North	.50
Plat and Profile Book for Engineers and Contractors,	Dunham	1.00

If you are thinking of buying books on any subject write to us.

THE ENGINEERING NEWS PUBLISHING CO.,

Chicago Branch:
1636 Monadnock Block.

Publication Office:
St. Paul Building, New York.

by the sentinel on the bridge, he replied, "I am Marshal Ney; I am the rear guard of the grand army; I have brought in the last gun; and there it sleeps in the bottom of the river," and he tossed it over the parapet. Pardon the story. Like Ney I am alone, no one to report to, or get a discharge from.

But if the Good Roads League is to continue its efforts to improve our road system, it must be done by preliminary steps, as in the first instance. Whoever walks in those steps, should be prepared for crosses and losses and vexatious annoyances, and many favors will be given, unthankfully received by many.

Verily the harvest is ready, but the laborers are few.

TABLE OF CONTENTS.

H. C. Pearsons, *Grand Haven Daily Tribune* i
Our Country Byways, *F. Hodgman* vii
The Engineer's Assistant, *Wm. B. Sears* xi
Our Absent Members, *J. J. Hubbell* xxiii
The United States Deputy Surveyor, *Dorr Skeels* xxv
The Ladies, *Col. E. W. Muenscher* xxix
The Country-Road Maker, *Wm. Appleton* xxxiii
Engineers' Personal Finances, *Geo. L. Wells* 3
The Sewerage of Pontiac, *H. E. Riggs* 13
A Barrel of Salt, *J. J. Hubbell* 31
Curb and Sidewalk Grades, *W. D. Elder* 45
Interlocking Switch and Signal Systems, *Alex. Moore* 57
Electrolysis, *R. C. Smith* 64
The Intakes of the Great Lakes, *Thomas W. Barrally* 69
Contract versus Day Labor, *E. W. Muenscher* 82
The Horseless Carriage, *Ransom E. Olds* 90
The Inspector and His Duties, *Harry Hodgman* 98
The Propeller-Wheel, *H. C. Pearsons* 101
A Case in Land Surveying, *F. Hodgman* 112
Materials for Street Paving 116
W. L. Coffinberry.—A Sketch, *Dorr Skeels* 125
Recent Legal Decisions 132
Report of Committee on Drain Laws and Legislation, *E. Strong* 169
Michigan Engineering Society, Annual Convention 172
Michigan Engineering Society, List of Members, 1898 191

INDEX TO ADVERTISEMENTS.

Alsedroth & Root Mfg. Co. 2d p. cover.
Lidgerwood Mfg. Co. 2d p. cover.
Milwaukee Cement Co. ii
Deane Steam Pump Co. iv
Michigan Brass and Iron Works. vi
W. H. Doyle—Railroad Ties, etc. viii
Detroit Graphite Mfg. Co. viii
Geo. M. Pierce—Duplex Catch-Basin Covers and Inlets. viii
Union Water Meter Co. viii
Electrical Engineer. x
Crown Fire Clay Co. x
Robinson Bros. Clay Co. x
Ingersoll-Sergeant Drill Co. xii
Pacific Flush Tank Co. xiv
Toledo Bridge Co. xvi
National Meter Co. xvi
Engineering Magazine. xviii
Union Akron Cement Co. xx
Michigan Agricultural College. xx
Atlas Cement Co. xxii
Blackmer & Post Pipe Co. xxiv
Evens & Howard Fire Brick Co. xxiv
Geo. N. Saegmuller—Astronomical and Eng. Instruments. xxvi
Buff & Berger—Engineering and Surveying Instruments. xxvi
Big Mountain Mining Co.—Coals. xxvi
International Correspondence Schools. xxvi
National Sewer Pipe Co. xxviii
R. D. Wood & Co. xxx
Talbot Paving Co. xxx
Michigan Eng. Soc. xxx
Thomson Meter Co. xxxii
Dry Dock Iron Works. 182
Sandusky Portland Cement. 182
Hersey Mfg. Co. 184
Massillon Bridge Co. 184
Meacham & Wright—Cement. 186
L. Beckmann, Surveying Inst. 186
Book of College and Other Poems 186
Lufkin Rule Co., Mensur'g Tapes 188
A. A. Griffing Iron Co. 188
Manual of Land Surveying, Surveyors' Tables, Field Book for Surveyors. 190
Wickes Water Tube Boiler. 192
Geo. M. Eddy & Co., Meas. Tapes. 192
Engineering Record. 194
James H. Rand, Banker. 196
Engineers' Instr. Exchange. 196
Buckeye Portland Cement Co. 196
James Leffel & Co., Water Wheels 196
Arbuckle-Ryan Co. 198
Michigan Engineers' Annual. 200
Engineering and Mining Journal xxxiv
D. H. Ranck Pub. Co. xxxiv
American Engineer. xxxiv
Railway Review. xxxiv
Adlake Camera. xxxvi
Engineering News Pub. Co. xxxviii
Louisville Cement Co. 3d p. cover.
Weston Electrical Co. 3d p. cover.
Jessops' Steel. 3d p. cover.
W. & L. E. Gurley. 4th p. cover.

Louisville Cement

THE UNDERSIGNED IS AGENT FOR THE FOLLOWING WORKS:—

Hulme Mills	Producing Star Brand
Speed Mills	Producing Star Brand
Queen City Mills	Producing Star Brand
Black Diamond Mills (River)	Producing Diamond Brand
Black Diamond Mills (Railroad)	Producing Diamond Brand
Falls City Mills	Producing Anchor Brand
Silver Creek Mills	Producing Acorn Brand
Eagle Mills	Producing Eagle Brand
Fern Leaf Mills	Producing Fern Leaf Brand
Peerless Mills	Producing Crown Brand
Lion Mills	Producing Lion Brand
Mason's Choice Mills	Producing Hammer and Trowel Brand
United States Mills	Producing Flag Brand

These works are the largest and best equipped in the United States. Orders for shipment to any part of the country will have prompt attention. Sales in 1892, 2,145,568 barrels.

WESTERN CEMENT CO.,

247 WEST MAIN ST., LOUISVILLE, KY.

THE WESTON STANDARD PORTABLE

VOLT-METERS
AMMETERS
WATTMETERS

Recognized as the Standard Throughout the World.

Weston Electrical Instrument Co.

114 WILLIAMS ST., NEWARK, N. J.

JESSOPS' STEEL.

The Best for Tools, Dies, Drills, Etc.

MEDAL WORLD'S COLUMBIAN EXPOSITION, 1893.
GOLD MEDAL, PARIS, 1889.

Wm. Jessops and Sons, Ltd.,

Manufactory, Sheffield, Eng.

Chief American Office,
91 JOHN STREET, - NEW YORK.

W. & L. E. GURLEY,

Troy, N. Y., U. S. A.

LARGEST MANUFACTURERS IN AMERICA OF

CIVIL ENGINEERS' AND SURVEYORS' INSTRUMENTS.

ESTABLISHED 1845.

TRANSITS, LEVELS, COMPASSES, PLANE TABLES, CURRENT METERS, LEVELING RODS, CHAINS, AND TAPE LINES.

ANEMOMETERS, BAROMETERS, ODOMETERS, FIELD GLASSES, TELESCOPES, DRAWING INSTRUMENTS, SCIENTIFIC BOOKS, Etc., Etc.

OUR LATEST ILLUSTRATED CATALOGUE AND PRICE-LIST MAILED ON APPLICATION.